The Journal
of the
Mysore Agricultural
and
Experimental Union.

VOL. II. DECEMBER 1920. No. 4

The Mysore Agricultural and Experimental Union.*

BY

Dr. Leslie C. Coleman, M.A., Ph.D.,

Director of Agriculture in Mysore.

THAT which distinguishes the Mysore Agricultural and Experimental Union from other Agricultural Associations in India is its avowed object of carrying on definite experiments. The reason why we consider this necessary lies in the fact that the Agricultural Department with its comparatively small staff and its small number of farms cannot hope to test inprovements under more than a few of the many soil and climatic conditions which exist in the State. In my opinion this part of our work is the most important as it is the most distinctive feature of our organization.

We have heard much during the past few years with regard to Experiment and Experimental farms when what is meant is demonstration and demonstration farms. The difference between the two seems fairly obvious and yet they are being continually confused. At the risk of telling you what you already know I should like to take a few minutes to discuss this question of experiment and demonstra-

* Opening Address delivered at the Third Annual Meeting of the Union on 4th November 1920.

tion. In this first place I need hardly point that in an agricultural experiment or on an Experimental Farm we are trying to find out something about some crop or some agricultural process which we do not already know. In an agricultural demonstration or on a demonstration farm we try to show or demonstrate some improved crop or method the value of which we have already ascertained by Experiment.

Agricultural Experiments are not easy to carry to a successful conclusion. They are very much more difficult than physical or chemical experiments in the first place because we are dealing with living things which have a perverse habit of doing things which we don't expect them to do. Moreover in a physical or chemical laboratory we can keep all the conditions of our experiment under rigid control and in fact we do this as a matter of course. In an agricultural experiment carried out in the open affected as it is by the vagaries of sun, wind, rain, soil, such control is impossible. At the best therefore agricultural experiments cannot lead quickly to such definite results as can be obtained from experiments in physics or chemistry. We have not only to repeat them much more frequently in one year on a given piece of soil and under a given climatic condition but we must also repeat them year after year till we have exhausted the possibilities of climatic influence.

A certain number of Experiments have been carried out by members during the past two years. The results of these are only very partially available and we shall have to wait till after the harvest season before they will be in our hands. These experiments which have to do chiefly with the testing of crop varieties have been carefully planned and as far as I have been able to see from inspection carefully carried out. I feel certain that they will be of very great value. They represent a great deal of painstaking work on the part of our members and we owe them our thanks and gratitude. We are just beginning this type of work. There is an immense amount to do and I trust that a very much larger number of members will co-operate during the coming year.

Up to the present we have been restricting our experimental work to the testing of crop varieties and to the testing of the cheaper improved implements. The changed agricultural conditions, I think,

justify us in expanding on new lines. The huge increase in value of agricultural produce makes the question of the application of commercial fertilizers to a large number of crops a very practical one. Before the war there was only a comparatively small number of crops in Mysore upon which commercial fertilizers could be used with profit. The conditions are now quite changed and I believe a whole series of experiments should be instituted to test the practicability of using commercial fertilizers for our staple food crops, such as ragi and jola. It is, I think, now quite clear that commercial fertilizers can be used with profit on paddy although we do not know the most profitable doses under the various soil conditions in the State. Here is a whole host of new questions which this Union should help in answering and upon the accurate answering of which depends the possibility of increasing rapidly our production of food.

Then we have too the question of the use of more expensive implements. I remember when I first came to Mysore we used to discuss gravely as to whether the Mysore Agriculturist would ever buy a plough which cost as much as twenty rupees. Such a question seems quite ludicrous now. We are selling ploughs by the thousand practically all of which cost more than Rs. 20 and these are going not to the well-to-do landholder but in a very large number of cases to the small ryot. We shall have to tackle the problem of the larger labour-saving implements and machinery. This problem is important not only because of the rise in value of agricultural produce but because of the rise in cost of agricultural labour.

Then again we have work with Live-stock. This is work with which our Union has had nothing to do up to the present. It is however a branch of agriculture which is of immense importance to the general development of the State and as such calls for the attention of this Union. The improvement of Live-stock is, I believe, a more difficult task than the improvement of crops, and it is a problem for the solution of which time is required. That seems to me an additional reason why we should tackle it without delay.

In addition to these new lines of work which are opening up before us I should like to call your attention to two which were discussed at our last meeting but upon which no practical action has been taken. These are (*a*) the question of mapping out and bring-

ing into practice among our members and others in the State of a simple system of Farm Accounts and (*b*) the question of starting on a small scale at least an Agricultural Survey. It is not for me to point the reasons why these have not received practical attention but should like to state very strongly that it is a great mistake to have on our programme of work subjects upon which practical action is not taken. Both of these appear on our programme for discussion again this year. I personally feel that if we do not see any prospect of practical action being taken during the coming year it would be wise to drop these subjects from our programme altogether.

Some farm operations with The Fordson Tractor, an Oliver Double Plow, Double 18″ x 6″ Disk Harrow and Martins 7 tine x 5′ Spring Cultivator.

BY

Mr. A. T. McIsaac,

Ganganhally Estate, Tavarakere P.O.

IT is not my aim here to demonstrate the financial point of view of the tractor in relation to bullock traction for any work on a farm or estate, but show what works have been accomplished. Since I started tractor cultivation it will be remembered that no one had experience either in driving the tractor and manipulating the plow, although it is in doing so and in laying out the field correctly that success and good results are obtained.

About one hundred acres, more or less, have been operated on, most of the fields having been out of cultivation and some never known to have been cultivated. The embankments and boundaries to most of the fields were covered with thorns and lantana and weeds, such as the sensitive plant, etc. In many cases these embankments took up an area in proportion of 5% to 10% of the cultivable area. The problem which confronted me was how best to clear these along with the inside field, and after some experience I found it best to plow them up and treat the whole as a big field and not cultivating each small field separately : in this way the embankments, many of them steeper than the angle of rest, were plowed up, lantana and other scrub jungle unrooted and vermin shifted.

New shares I find best suited for this work. The breakage of shares I have had two only—these were caused by the shares going into thick roots about 6″ in diameter. The share generally gets under and if the root does not break the motor is brought to a stop and the root cut with an implement which one of our members* recommended for extracting lantana. It is most useful, either to cut a root up to 6″ diameter or unearth a boulder. I use this mattock regularly now as an adjunct to the field outfit. In negotiating large trees there is no difficulty excepting with the roots. Large stones well out of the ground are plowed round about and when the engine speed and steering is carefully manipulated little land is left to be weeded or left uncultivated. Stones just on the surface or gone right over and the plow lifted without stop and dropped in on the other side. After experience these give little trouble. Often a large stone hidden will bring the engine to a stand when it is backed and the plow lifted and gone over, the spot marked and the stone taken out and left on the surface to be dealt with later on. With smaller stones of a foot or less in diameter the plow generally gets over them, shivers and staggers or jumps clean out of the stones if caught dead on but goes on without stop or damage and much that was thought dangerous can now be got over without trouble. Some of the lands plowed consists of red stiff sticky soil, when wet it sticks to and fouls the mould boards of the plow even though they are clean and burnished ; soil of this type is rather hard to work till it has been turned up and broken. I would say an implement of the Grubber type is best suited for first cultivation, followed by cross plowing. Red sandy soil is easy to plow and the maximum depth can be plowed the first time. The wear and tear of the tackle on this type of soil is about 50 to 100 per cent less than on say a red soil mixed with white flinty stones which very often are just under the plowing depth of the country plow. A field of less than five acres will almost wear away a pair of 14″ shares, in first plowing but is easy to work when broken up. Soil of this type, I find, generally grows good crops. Wet land soil is generally easy to plow if it has been in cultivation, but I have found some of it very hard and tough and takes a lot of weathering and green manure to bring it into a good cropping condition. Black soil I have none.

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* Mr. R. Gopalasamy Iyer.

Deep plowing, does it pay ? During the first year I hardly think; in the second year land so plowed is easier of cultivation by about 50 per cent, weeds are less in evidence provided the surface soil plowed under is not brought to the surface in after-cultivation till it has fully decayed. In this direction it will be safe to plow lightly in dry land and bring up the subsoil gradually, and, but for the retention of moisture I don't think it advisable to do deep plowing. For sugar-cane and heavily manured crops it does not matter so much.

For digging surface water channels the motor tractor with a plow is very useful, or for throwing up a ridge to prevent wash ; it saves a large amount of manual labour. For orchard work, such as root pruning the tractor plow is most useful, and a tree plowed on the four sides at the correct distance and the depth with the double disk harrow used close up to the tree is a very simple matter and makes work in an orchard easy, less head clearance, as in the case of mangoes, is required than for bullocks.

There are few corners that the tractor cannot be worked in amongst trees and palms planted in all sorts of corners and not in rows. The tractor winds in and out just clearing the trunks either with the plow or disk behind it doing the cultivation at any desired depth, and useful crops can be raised between, either as manure or to cover expenses, as horsegram or groundnuts.

I have also found it very useful in preparing new orchard in land which has enabled me to plant approximately 15 acres, root prune and cultivate about 20 acres consisting of coconut, mango, jack-fruit, etc., at the right season, and deep plowing round other trees to prevent their roots damaging and exhausting the moisture of field crops.

The motor also can be used for driving any Farm or Estate machinery as sugarcane mill or for pumping water. I have used it to drive a thrashing machine on a 4-hour non-stop test satisfactorily at various speeds.

Farm tractor drivers should get a special training and know every part of the engine and be able to take it down and put it together without having to send or get it done in a workshop. He should also know farm work, cultivating both in the orchard and

open field and how best to lay out his work to advantage. He will have to know about plows and their constructions, and working, cane-crushing or any of the various jobs about an Estate or Farm.

The practical work that a tractor on a Farm is capable of doing will be in proportion to the skill of the man who operates it. Mistakes will be made, but as knowledge and experience are gained, so will the uses; to judge what will be the best tractor till time and experience has decided for us in practice, and the comparison as to whether it will pay as against bullocks this will decide itself. In the meantime it will be used as a help on a Farm and as an implement for doing work which cattle by their strength are limited to do. Cattle will always be with us on a farm for a long time and occupy the chief position, but where a tractor is kept the bullock's life will be less strenuous. Plowman will also be required but they will be less, mostly employed doing the hundred and one jobs on an up-to-date farm as harvesting special crops and fighting insects and other pests. Work will be less laborious and both man and beast will benefit therefrom.

Some of the chief troubles experienced are caused by the Agents and Importers failing to supply renewals, as shares and land sides, the most important parts, and also other renewals, and until dealers and importers be made to supply such parts the owner of such an outfit is entirely held up and without redress. Can this be righted ?

Much of my work has had to lie over for want of spares as above and works taken in hand unfinished and a season lost. Moral to would-be buyers. " Have nothing to do with importers and dealers who cannot give a guarantee that renewals will be supplied for all parts of the machines purchased *as required* and not on the high Seas or on a Foreign land."

The Improvement of Cattle in Mysore.

I.

BY

Mr. N. Krishna Iyengar, B.A.,

Inamdar, Ooraghally Estate. *

As I have been asked only to open the discussion I shall not take up your time by making a speech but shall content myself by offering a few preliminary remarks as regards the importance of the subject and mentioning a few points which I think may be brought to your notice.

From time immemorial cattle have been the chief object of man's care and attention. They have been his only chief asset and wealth. From the earliest periods of savagery and nomadic life man has directed his best efforts towards the preservation, multiplication and improvement of his livestock. This has urged him to migrate from country to country, prompted him to take to agriculture and improve it, and induced him to launch upon industrial pursuits and trade. Not merely this much. To this may be traced the beginnings of all diplomacy, warface, intrigue, bloodshed, conquest and civilization—in short, all the sufferings and blessings of humanity from the beginning of the world to the present time. In regard to India especially this has been the case. The religious and historical literature of our country is full of evidence in this regard. The importance of livestock has been so highly appreciated by us that it has been worked even into our religion and a certain amount of sanctity has been attached to the keeping and improvement of cattle and their destruction has been condemned as a sinful act. In order to facilitate the proper bringing up of cattle and promote their multiplication various conveniences have been created and it has been enjoined on all classes as a part of their duty. Free pastures have been set apart and rights and privileges granted and conferred to this end and gifts of cattle enjoined on religious and ceremonial occasions.

* Speech with which the discussion on "Improvement of Cattle" was opened at the General Meeting of the Union on the 5th November 1920.

We have gone even further. We have effected even their deification and induced the people to devote their very best attention to the subject. As one of the best methods serving to improve the breed of cattle provision seems to have been made by the introduction of the system of selecting the best bulls and allowing them to roam about freely in the village herd, either as the village common property or the property of the village temple. These selected sires being well fed and taken care of have been able to keep away from the cows, the weak and immature and defective bulls and produced a good and strong progeny. Of late this system has given place to a better and more convenient method, namely of some well-to-do ryots maintaining stud bulls for service on payment of fees. There seems to be, however, one defect in the working of this system which deserves to be mentioned. Greed of money has unfortunately prompted these persons to over use immature bulls and in consequence the quality of the progeny has suffered by being not true to type and poorer in physique and development.

Another point to which I would invite your attention is the case of feeding and housing the cattle. Sufficient attention to these points does not seem to be generally bestowed by cattle breeders in very many parts of the State. It is rather curious that persons from jungly and well-wooded parts go in search of good strain of cattle to villages situated in maidan parts where physical conditions are not suited to the maintenance of large herds of cattle. This is probably due to system of stall-feeding in vogue in the maidan villages which seems to have a direct bearing on the increased productivity of the cattle. Besides the health of the cattle being uniformly maintained by this system the death-rate among these cattle is reduced to a minimum. Methods should be devised to bring about similar results even in parts where the practice of stall-feeding and growing fodder crops is not in vogue.

During the Mysore Wars the commanders of British armies discovered that Tippu was able to transport his heavy guns and baggage with comparative ease over long distances and bad roads chiefly on account of the good bullocks used to draw the gun carriages and transport carts. After Tippu's fall the British took care to maintain and improve Tippu's cattle which was known as the Amrita Mahal

cattle and from these cattle the Mysore breed of cattle has attained wide reputation. This has resulted in a large demand for the Mysore cattle. To meet this ever-increasing demand we have to endeavour our best. The suggestion made by some persons to prohibit the export of cattle from Mysore in order to bring down the local market price appears to me to be a suicidal policy. With these remarks I beg leave to resume my seat.

Improvement of Cattle.

II.

BY

W. Davison, B.S.A.,

Livestock Expert in Mysore. *

To attempt to give a complete survey of the cattle situation in Mysore, as it exists to-day, in the brief time allotted, would show either supreme optimism, or a contempt for the subject which it by no means deserves. It seems well therefore to bring out in brief, the main points wherein the cattle industry is deficient and to indicate the main avenues which should be taken to effect improvement.

The first and most obvious feature of the subject, and the one of prime importance withal is the indiscriminate manner in which breeding is carried out. This is noticeable by all, and there should be no necessity to enlargeit, upon nor to enumerate cases. The remedy is equally obvious, but may be briefly stated here. The good sire is the key to the gateway of improvement, but it must be borne in mind that breeds should be maintained as such, and the use of good sires of different breeds from the main stock is only permissible in special cases. This is especially true in Mysore. Here we have a breed of draught cattle, good specimens of which are unrivalled in other parts of India, and it is this particular breed which should be boosted in Mysore to the utmost. The introduction of milch cattle for dairying purposes, sound as it is, as a policy under certain circumstances, should not be allowed to become rampant, and no attempt should be made to combine the two qualities of high milk production and good draught qualities in one animal at least by the process of cross-breeding. It is of course acknowledged that good milking

* Paper read at discussion referred to.

mothers are of more value, and the production of such animals by selection within the breed, and a definite policy of breeding is to be encouraged but any attempt to obtain such an end by crossing with European breeds, when the production of draught cattle is the aim, would tend to eliminate those characteristics which make the Mysore bullock so desirable. It is necessary then to keep a clear conception in the mind's eye of the needs of the two branches of cattle production and to keep them distinct and apart from each other. This is a point which needs emphasis, for experience in other countries has shown the tendency on the part of the breeder to attempt such flights of combination, as well as the disastrous results obtained. It is admitted that dual purpose animals exist and are raised with a certain degree of success, but the failures do not gain much publicity and success is only obtained where the breeder has a clear and defined ideal, a determination which does not waver and a system of breeding which necessitates the retention of his breeding stock for the observation of results and the concentration of required points. In a country where trading is more freely practised than breeding, and animals change hands so frequently, an attempt to evolve a dual purpose or combination breed on a large scale would lead to certain disaster and the extinction of the good type animals which already exist, for such practices are synonymous with a non-continuity of policy.

The course of action then which should be adopted consists of (1) improving the milking cattle in and around cities by cross-breeding with a view to evolution of sufficient high producing animals for the local needs, and (2) the improvement of the draught type by purifying the draught breeds and selecting for breeding those animals which will maintain and improve the characteristics for which the breed is required and has obtained notoriety in other countries. The latter phase is of the largest importance, in that it concerns the greatest number of raiyats, and that the foundation for such work is already in existence, and we may in this instance confine ourselves thereto.

The two chief means of overcoming indiscriminate breeding are the more general use of good bulls, and a sweeping policy of castration of all male animals which cannot be classed in that category. Propaganda work is necessary in each case. That is work in which the members of the Experimental Union can render material assist-

ance, in encouraging the use of good bulls, making more public the concessions offered by Government to those who desire to raise a high grade class of cattle, and by preaching the gospel of early castration whenever the opportunity offers.

If good calves are to be bred, it is a difficult matter to lay too much emphasis on the power of good bulls, for even on poor cows they will improve the progeny, but during the rearing too much faith in the prepotency of the sire is misplaced. Proper nutrition is necessary to all growing animals if they are to attain constitution, development and an early maturity all of which are essentials in any breed. That animals are insufficiently fed in Mysore is common knowledge and daily testimony to that statement is thrust before us in all districts, not only in sections where famine conditions exist. The common reason given for this state of affairs is the lack of good pastures, and the scarcity of fodder but never have I had it so much as hinted to me that the number of cattle maintained was too great, and it is here that the mistake is made. Figures are not easy to obtain on this point, but it would be interesting to know the number of cattle which are maintained in the State purely for the purpose of manufacturing manure, a paradoxical business when we remember that the amount of manure made depends always on the amount of feed fed. The agricultural prosperity of this or any other State is in no way improved by an increase of the number of cattle, but rather by the increase of good and useful cattle and decrease of ill-nourished, half grown and useless cattle, and this is a point to be borne in mind in proposing steps for improving the situation. It is clear that this is one of the places where deduction from statistical information may be very misleading.

As a direct result of improper nourishment is the fact that ryots impatient of the slow development of their heifers, allow them to breed before they have reached their full growth. This has a detrimental effect, not only on the heifer itself, but also upon the calf, for in trying to do two things at once it is unable to accomplish either properly and thus both animals are stunted. If one conceives this going on for several generations, no stretch of the imagination is needed to foresee a still worse state of affairs than exists at present. That is however a pessimistic occupation in which it is not well to

indulge, but at the same time should have a healthy influence if used occasionally as a corrective for passivity and undue optimism.

The question of a remedial measures is one which calls for vigorous action. More publicity is certainly needed, first of all in regard to the concessions given by Government to encourage the breeding of better stock. There seems to be a good deal of haziness in the minds of those who know of these concessions, and a larger percentage of the people who are not aware of them at all and it is the intention of this Department to try to overcome this by means of a campaign of advertisement. The first necessity however is a source of good bulls for distribution. A large scale distribution of bulls cannot be carried out at present, as circumstances do not permit of such action. The prices which rule for first class breeding animals is in itself deterrent, but the difficulty in obtaining these animals at any cost is the greatest barrier, and the first necessity is the arrangement of a farm or some source where stock can be bred in sufficient numbers to ensure a sufficient supply. There is at the same time no question as to the need for generous castration, and I may be pardoned for reiterating the statement that unless a strong and sweeping policy of castration be adopted by breeders of all classes, no real and appreciable progress can be anticipated. This is a matter which needs the support and indeed more than that of all who are interested in the subject, not only by precept, which is of considerable value, but by example which is more so. Legislation, on this point, seems to be out of the question at present for various reasons, but were it a feasible idea I would be very strongly in favour of it, as undoubtedly it is one of the most important features of the livestock industry.

The Improvement of Cattle in Mysore.*

III

BY

S. Srinivasan, Esq.,

Veterinary Inspector.

MYSORE is for years noted for its excellent cattle with its salubrious climate, extensive grazing plots, water facilities and fertile soil the country is best suited for cattle-breeding and rearing. The large number of fine cattle that are annually exported is not being replaced by those of proper scientific breeding, the principles and objects of which have not been correctly understood by the cattle owners who are said to be interested in breeding cattle are therefore getting degenerated from day to day.

The primary object of cattle-breeding in the State is for milking and draught purposes. Our cattle to a certain extent serves the latter purpose but not the former. So milk supply has become the greatest problem of the day engaging the attention of the public as well as the Government. Of the different breeds Mahadeswara-bettada cows are considered to be the best milkers in the State, but they cannot be compared with milkers of other parts of India. My chief object therefore in suggesting certain proposals is to develop our cattle into such ones as would yield more milk and do better work.

Although the total strength of cattle in the State is about 69,34,500, the number of working bullocks actually available for agricultural operations extending over an area of 78,02,121 acres is 16,83,239 which gives approximately one pair of bullocks for every 8 acres of land. The large exportation and also the losses due to various causes without any proportionate replenishment have certainly been leaving the country poorer and poorer in cattle and our agricultural operations cannot at this rate go on without being materially hampered. It is therefore a matter for serious consideration to improve the breeds with reference to their quality and quantity.

* Paper read at discussion referred to.

The most important indigenous breeds of the State are —

1. Hallikar,
2. Bettada dana,
3. Chitaldrug breed,
4. Nadu dana,
5. Kankanahalli cattle,
6. Bettadapur cattle, and
7. Amrit Mahal cattle.

I do not intend to enumerate the qualities of breeds but to see how they can be improved so as to give more milk and better working stock. Our cattle now are of miscellaneous lot. Except the Amrit Mahal cattle which are under the direct control of the Government the rest are entirely in the management of illiterate private cattle owners. To bring about the desired improvements is, indeed, not the work of a day or of any single individual, but the result of an uphill work for years on the part of the raiyats and the Government.

The present system of maintaining bulls in the villages is most unsatisfactory. No thought is ever bestowed on the type of bulls selected to suit the cows of a locality. They are only kept for the sake of making money and not with any object of improving the breed as could easily be seen from the indiscriminate allowance to cover even 5 or 6 cows a day. What good results can one hope to achieve in the breeds when they are confusedly mixed up by injudicious management through ignorance.

Now the responsibility of improving the breeds is far greater than is ordinarily imagined. In order to educate the cattle owners and effect speedy improvements in the breeds, I would suggest firstly, through education of the raiyats in the management of their cattle both in health and disease by holding out practical demonstrations and by constant lecturing, secondly formation of Experimental Breeding Farms here and there in breeding areas and thereby— organization of Breeding Associations among the interested cattle owners. Each of the above has its own sphere of work and usefulness. The Farms will conduct experiments and demonstrations of every kind pertaining to breeding on the most up to date scientific lines besides being educative centres in every branch of the science of livestock and the associations will be the promoters of actual breed-

ing operations on a large scale on the suggestions and advice given by the Farms. The actual working of the Farms and Associations is of varied nature and interest and forms a different subject which cannot be detailed here for want of time. It shall therefore be kept for future discussion if the suggestions are approved.

The Farmer in Germany.*

BY

Dr. B. Narasimha Iyengar, B.A., Ph.D.,

Agricultural Chemist.

It is a fact well-known to us all that Germany is not only an industrial country but an agricultural one too. Without going into the details of the size of holdings in different parts of the country, I shall simply make the general statement that all sizes of holdings—small, medium and large, are well represented in the country as a whole. During the five and a half years that I spent in the country, I had many an opportunity of closely observing the activities of farmers of all grades, and I shall give you a few of the impressions then gained.

The simplest farmer is one that cultivates his land himself with the aid of the members of his own family. He generally possesses a couple of cows which he uses for ploughing his land and carting the manure to the fields and the produce to his house. Once upon a time, the lands of a village were the common property of all the villagers and each had a portion allotted to him. According to the then existing custom he had no freedom of cultivating the land as he pleased, but had to follow a three-year rotation called the 'Norfolk Rotation'. The whole land was divided into three blocks, and each family had a share in each block. Hence it comes that even to-day, a farmer in many parts of Germany has his holding scattered in three different parts of a village.

During the working season, he gets early in the morning, puts his cows to the cart with his tillage implements in it and drives to his fields. He now begins his tillage operations and continues till the time of his midday meal which is usually brought by his wife or daughter. After a brief rest to himself and his cattle, he starts his

* Paper contributed for the General Meeting of the Union, November 1920.

operations again and continues till 7 or 8 P.M. in the evening, it does not get dark till 9 or 10 P.M. in high summer—and then goes home. After attending to his cattle and a couple of pigs which he might be fattening, he takes his evening meal and retires to rest. His two cows serve him not only as working animals, but produce the necessary manure for his land and furnish his household with milk as well.

This kind of small farmer cannot and does not cater for the market. His first business is to grow the necessaries for his household and fodder for his cattle. Unlike in our country, even the smallest peasant there sets apart a part of his land for fodder crops. The straw from the grain crops is usually used for littering the cattle-stall. He does not possess any very complicated agricultural implements, such as a modern seed-drill. In addition to such implements as ploughs, cultivators and harrows which can be transported in his cart to and from his fields, he usually has a hand thresher and winnower. Even the threshing, he does not do at one stretch. In late autumn and winter when he has no field operations to attend to, he does the threshing with the help of his family. His machine does not thresh out the grain thoroughly and so he has recourse to the flail. This gives him exercise too to keep him warm and fit in winter. In addition to attending to the indoor agricultural operations in winter, many of the farmers of this class do some linen-weaving as well.

The farmer answering to the description given above is usually called a 'cow-farmer'. One of a better class with more land to cultivate and the necessary capital at his disposal is called a 'horse-farmer'. His farming is carried on by himself, his family and some hired labourers as well. As his very designation implies, he uses horses for his agricultural operations and keeps his cows for milking purposes. In addition to horses he might have bullocks as well, and it is not at all uncommon to see a horse and a bullock harnessed together to a plough or a cart. Even this kind of farmer lives in the village and his lands are situated a certain distance from the house. In addition to supplying the needs of his own family, he produces something to sell in the market as well. While he looks to the production of grain and root crops, his wife looks after the pig-fattening and poultry-rearing. Not infrequently, a small house-dairy is main-

tained as well—a cream separator and a butter churn forming the usual outfit.

Between the horse-farmer described above and the big landed proprietors cultivating hundreds and thousands of acres, there are farms and farmers of all intermediate stages. With the increase in the size of the holding comes an increase in the invested capital and the staff, etc., needed for its management. Besides the usual labourers, there are the necessary overseers and the requisite staff for carrying on correspondence, keeping accounts, etc. The bigger farms must necessarily be run as commercial concerns. Some of them have specialized in their activities, for example, seed production, meat production, etc. Animal breeding too is carried on by those who feel themselves qualified for it. The simpler tillage implements of the 'cow' and the 'horse' farmer are replaced by more complicated ones. Where necessary and convenient, steam ploughing is resorted to. Artificial manures are applied on a very large scale. The harvesting is done not by sickles but by reaping and binding machines, and steam threshers take the place of the hand thresher.

On the small farms, the couple of servants that may be employed usually live in the family itself. On the larger farms, the labourers are paid not only in coin but also partly in kind, specially potatoes forming part of the wages. Some landed proprietors run a sort of kitchen as well for the convenience of the labourers. The bigger farms are dependent on season-labourers from Poland and Russia who come into the country early in spring and go home late in autumn with their savings. It is not everywhere that these wandering labourers are properly housed.

These large estates are not always owned by those who are managing them. The former Church lands and the State Domains are always leased out by Government for a certain number of years. The term is usually a long one and is sometimes continued for generations. Many capitalists and men of culture with the highest University training frequently take up such estates and carry on the concerns on a scientific and commercial basis. Thus, every grade of intelligence is represented in the farming life of Germany.

The artificial manures are largely used in that country to supplement the usually available cattle manure. Even to this day there are

vast stretches of the country where nothing but cattle manure is used. "Show me your manure and I'll tell you what sort of a farmer you are" is an oft quoted proverb in that country. So I shall conclude this paper with a brief description of the methods of preserving cattle manure, the basis of all agricultural prosperity.

As a general rule, the cattle are all well-fed and well-housed. The quality of the manure depends, as is well-known to a certain extent at least, on the quality of food given to the animals. Another important factor which contributes to the quality of the manure is the care taken of it. From what I have seen and heard, I cannot say that the smallest farmer takes much care about the manure. There is usually no covering on the heaps or pits and one usually finds the liquid part of it freely running to the street drains. It is only on the big and middle-sized farms that the liquid and solid parts of the manure are preserved separately. This necessitates the constructing of special drains and pits, and the use of a barrel and pump to dispose off the liquid part. In addition to these methods of making manure in which the stalls are cleaned out every day, there is another method called the box system in which the manure is removed from the stall only to be carted to the fields. This necessitates the construction of the special flooring for the stalls, use of ample litter to absorb the urine and keep the cattle comfortable, and movable feeding-troughs capable of being raised as the level of the floor changes with the accumulation of manure. There is no doubt that the box manure produced in this way is rich in nitrogen but whether all the nitrogen so preserved does reach the land at all is still disputed by investigators in that country. A good part of the nitrogen so preserved seems to get lost when the stall is emptied and the manure carted out. Moreover, the box system is not compatible with the scrupulous cleanliness essential for dairy animals. Chemical preservatives, such as ferrous sulphate, superphosphate and dilute sulphuric acid have been tried. Though they do help a great deal in reducing the losses of nitrogen, yet they have proved rather dangerous to the cattle in the hands of the ignorant workmen who are actually entrusted with using the chemicals in the stalls. The best, cheapest and safest method is found to be that in which the heap is kept moist and trampled tight. It has also been found advantageous to put a layer of old manure on the bottom of a pit and then heap fresh manure on it.

Such in every brief outline is the Farmer in Germany and the subject is by no means exhausted. In fact many of the statements made need amplification, discussion, and corroboration by statistics which is unfortunately out of the scope of this paper.

Sugarcane Cultivation in Kadur District.

BY

S. H. Bennur, Esq., L.Ag.,

Agricultural Inspector, Kadur.

THE average area under sugarcane in this District is about 1,700 acres. The great bulk of it is under tanks and river channels and is distributed as follows :—

(1) About 500 acres under the Madag tank, Kadur Taluk ; (2) about 500 acres under the Ayyanakere tank, Kadur Taluk ; (3) about 400 acres under Belvadi tank, Chikmagalur Taluk. Small patches of about half to one acre, however, abound in the Malnad Taluks of Koppa, Mudagere and Narasimharajpur Sub-Taluk and likewise in the semi-malnad Taluks of Tarikere and Chickmagalur. The area is subject to fluctuation owing to the following factors, which also affect production and distribution.

The most important of these is the price of jaggery. Whenever the prices are high the ryots rush to cane cultivation indiscriminately and the area increases. They feel that there is money in it. This goes on until the supply of jaggery is so great that owing to want of demand the prices are brought down to an irreducible minimum. Then cane-growing becomes an unprofitable concern and is abandoned by many a ryot. The prices are also controlled by the economic condition of the public. In a year of adversity when people have hardly enough to keep their body and soul together jaggery which is a luxury is never thought of. On the other hand a year of plenty brings in a large number of consumers who will be willing to pay more money for jaggery. The demand will be more, prices will rise and correspondingly the area under cane will increase also.

The second factor which affects the area is the supply of water in the tanks. Unless this is assured and is sufficient to pull the crop

through until the return of the next monsoon no ryot will be so foolish as to plant cane.

The Ayyan and Madag tanks as well as those of the malnad depend upon the south-west monsoon ; while the tanks of the maidan and semi-malnad get their full supply of water by the north-east monsoon. When the monsoons are good and the tanks full the cane area is naturally more.

As cane cultivation requires large amounts of labour and capital want of these comes in the way of its cultivation on a large scale even though the prices of jaggery and water-supply are favourable.

Varieties.

Pattapatti is the cane of the District though Cheni is cultivated on a small scale in some portions. It tillers well and wants high cultivation, good drainage and heavy manuring . Under very favourable circumstances it yields up to 250 maunds to the acre, though the average is much less. Being top-heavy it lodges freely and is liable to destruction by pigs and jackals.

The Department has recently introduced the Red Mauritius which is supplanting the Pattapatti especially in the malnad. It has extended very well in the Mudagere and Koppa Taluks. It has very many good qualities. It does not for instance lodge like Pattapatti and is not attacked by wild animals. It is more vigorous and yields more tonnage and thus a greater quantity of jaggery. It is, however, harder to mill and produces a dark coloured and softer jaggery ; but these disadvantages are more than outweighed by the increased yield of jaggery and thus a greater return of money. But a variety that is as vigorous as Red Mauritius and produces at the same time a better quality of jaggery is certainly more welcome. The evolution of such a variety from among the seedling canes is eagerly awaited.

Another variety that we are introducing is Java. It is more or less a semi-malnad cane and thrives specially well in the heavy soil of Kadur and Tarikere Taluks. It matures earlier, and is fairly drought resistant. It yields a rich juice that boils into a fine coloured jaggery. It is hard and equally proof against the attack of jackals and pigs. But it lodges badly and does not produce a big tonnage of canes or a heavy return of jaggery.

Period of Growth.

It is customary to allow cane to grow for fourteen to eighteen months in the semi-malnad portions of the District. The main reason is that cane planted in September and October does not mature before the corresponding months of next year as the moist weather then prevailing will still force the growth of the plants and prevent their maturity. The green colour will not fade and the juice will not get rich until the advent of dry weather. The cane thus takes 15 to 18 months in these localities. The cane growers also feel that a better growth and consequently a greater tonnage will result by allowing cane to grow longer than 12 months or even 18 months. Even Red Mauritius planted in July stood well for 18 months and produced richer juice and better tonnage. Pattapatti planted in heavy soils that do not dry well in summer keeps green in Chickmagalur and Sakarayapatna even after 12 months. Thus cane planted in January may very advantageously be allowed to grow until March or April next year *i.e.*, 15 to 16 months.

Soil Cultivation, etc.

In the Malnad good paddy or wet land is chosen for cane. It is generally silty sand or loam. The plots being small, digging will have to be resorted to in most cases. In the maidan where the plots are bigger heavy wooden ploughs are used 5 or 6 times to bring the soil to fine tilth to a depth of 5 inches. Clods are crushed by means of hand mallets and land levelled with the log harrow or Mara.

Both pit and furrow systems of planting are in vogue. The former specially is found in the Malnad where water scarcity exists in an acute form at the time of planting. Pits are arranged at distances of about one yard apart each way and buds of two eyes are planted in twos in each of these pits which are hand-watered every now and then. In the furrow system double rows of sets are put in and water is turned in from the beginning.

For seeds tops are generally preferred as they should be, since these give more uniform and rapid germination.

After-cultivation.

When the sugarcane is three months old inter-cultivation is done in the maidan area and wrapping and supporting canes by bamboos

is attended to later on. If a ryot has sufficient labour and capital he will at the same time apply cattle manure one basketful (about 20 lbs.) to each pit and earth up the cane. In the malnad area ridging and earthing is done compulsorily to maintain efficient drainage.

Drainage.

Drainage is very essential in the Malnad to carry off the excess water of the heavy rain. But, this is very inefficiently done here. Drains are too narrow and shallow. The small patches of cane are surrounded on all sides by paddy lands. The result of this will be that cane is heavily water-logged and turns yellow in no time during monsoon. If the main drains are dug deeper extra water from the plot will easily drain away. It is even advisable to open wide and deep main cross drains in the plot itself. The branch drains have also to be broader and deeper. To do drainage efficiently the cane must be planted somewhat wider apart.

Rotation.

The main rotation is a sugarcane paddy one in the malnad area. It is obviously an undesirable combination. It is, however, not possible to change it as paddy is the staple food crop in the malnad. In the maidan area sugarcane is rotated with coriander, awarre, menthya, potatoe, uddu, etc.

Manuring.

General manures, such as sheep folding and cattle dung are the only ones that are being applied when the land is under preparation. Experience clearly shows that initial manuring of some sort is very necessary before planting, in view to give a good start to cane. Sugarcane thrives better if manure is applied in repeated doses instead of in one lot. To obtain decent crop about 35 to 40 maunds groundnut oil cake powder seems to be necessary. This is one of the heaviest items of expenditure involved ; but a handsome return is always obtained ; and besides, the residual nitrogen brings about a striking increase in the yield of paddy or other crop coming after sugarcane. Sugarcane growers are gradually realizing the fact that the use of oil-cake to sugarcane is profitable. Some cultivators do somehow hold that it generally induces excessive vegetative growth, without a proportionate formation of sucrose and besides prolongs

the ripening period. Whether there is any truth in this or not the huge extra growth and the consequent extra yield of jaggery make the application worth its while.

Green manuring is good and may be tried by growing cow-pea between the lines of cane ; for this the lines have to be a bit apart (about 4 feet from each other).

Ashes and burnt earth are favourite manures in the malnad and their effect seems to be very good wherever the application is made.

Ravages of Pigs and Jackals.

Wild pigs are to be found in abundance in almost all the taluks of the district. They are so numerous that the living of the cultivator himself has become somewhat precarious. In Danavas (Narasimharajapura Sub-Taluk) and in some places in Lakkavalli hobli (Tarikere Taluk) sugarcane has gone out of cultivation owing to their ravages. A few pigs can damage a considerable quantity of sugarcane in one night. Only two ways of combating this evil are practised at present to a little extent in the malnad.

(1) Erecting an efficient bamboo fence.

(2) Killing the pigs in the jungle.

Bamboo fencing is rarely seen now as bamboo cannot be had in plenty. The plants all ran to seed sometime ago and died. The dried portion was burnt by accidental fire ; so there is little chance of getting more bamboos in sufficient quantity for sometime to come.

The second one is undoubtedly the best method : but it is not always carried on. Only, when the transplantation of paddy is completed a few village people who have their hands idle go out on shikar on Mondays. But, when paddy becomes ready for harvest they stop short and attend to other work. But this should be encouraged and organized on a co-operative scale. A tract of 10 to 20 villages should join together and employ shikaries or award handsome prizes to people that shoot the wild animals. Each cultivator from this tract should pay a fixed contribution amounting to 6 pies per rupee of assessment. From the amount collected, rewards of Rs. 2 for a full grown pig and rupee one for a small pig should be given. These prizes will tempt professional shikaries, who should be made to stay in that tract. If Government recognize these clubs and help them

by giving regular grants to encourage pig destruction the number of these wild animals will speedily be reduced to an easily controllable limit. This will then remove one formidable obstacle in the way of cane cultivation which is then bound to extend.

Manufacture.

The old wooden mills have been superseded by an iron three-roller mill made in Madras. These are not owned by sugarcane growers in the majority of places. Professional jaggery boilers from Channarayapatna of the Hassan District go round the sugarcane growing centres with complete outfits—mills, pans, he-buffaloes and all. Sometimes, they actually purchase wholesale the standing crop itself. These mills are not so efficient as the Punjab Nahan mill introduced by the department in this District.

Generally, a round pan with flaring sides is used for boiling the juice and the single furnace system is usually adopted. In the malnad Taluks very small pans are used and most of the sugarcane growers are astonishingly ignorant of preparing good jaggery. They fill the pan with juice to the very brim to a depth of more than one foot. The juice thus takes a very long time to boil and concentrate. In some places in the malnad lime is not used at all. The oven is too narrow and proper combustion does not take place as no provision is made for air drought, ash pit, etc. The process is very slow, as it is bound to be, hardly 4 to 5 maunds of jaggery are produced in a day of 24 hours in the small pans. Big size pans turn out ten maunds. Coming to fuel required for boiling the juice, begasse and trash are used in bundles. Apart from this one cart-load of dry fuel is required for one boiling. In rainy season about two cart-loads are required, for one boiling *i.e.*, 10 maunds of jaggery. Jaggery produced is not good. Skimming the juice is not practised at all. The finished product is poured on mould that has numerous small holes. Jaggery is thus marketed in very small pyramidal blocks. The product is generally over-boiled in the maidan. In the malnad it is under-boiled and filled in semi-solid condition in tins or earthen pots. This latter will never find any market outside the malnad.

The new system of multiple furnace is becoming popular as it is capable of using the heat of the waste gas and thus minimises the

quantity of fuel required to boil the juice to a certain extent; besides, it makes skimming easier. Juice is filtered easily and proper combustion is maintained. It is found by experience and demonstration during the last 5 years that, by the improved furnace and pans recommended by the department, good solid jaggery not liable to run in wet weather, could be made in the malnad. This can be exported quite easily and finds a ready market outside.

It is an important problem to increase the yield of sugarcane at the present time, when the price of jaggery is ruling so high. The demand for jaggery is continuously increasing while its production by extension of area, etc., does not show a consistent increase. A huge area with perennial water-supply is seen lying waste in the Jagar Hobli in the Chickmagalur Taluk. Similar areas are found in the interior of Koppa and Mudigere Taluks. All these areas are capable of growing a profitable sugarcane crop. There is thus a wide scope for the introduction of improvements recommended by the department *viz.*, growing better varieties, introducing green manure, applying oil-cake and adopting other intensive methods of cultivation which will result in a good margin of profit practically throughout the whole district. This is chiefly dependent on irrigation facilities, sufficient labour and capital and intelligent supervision. It is, therefore, hoped that the wealthier cultivators of both malnad and maidan in the district will seriously consider the possibilities and will take a lead in bringing about these improvements and thus ultimately raise the standard of Agricultural practice of the District.

The Collection of Economic Statistics.*

BY

S. N. Appannaiyengar, B.A., B.L.,

Secretary, Board of Agriculture.

I owe it to the generosity of the Managing Committee of the Agricultural and Experimental Union to which I have the honour to belong, that I stand before you charged with the duty of leading a discussion on the important but neglected subject of "The Collec-

* Paper read at the General Meeting of the Union, November 1920.

tion of Economic Statistics." At the outset, I need not tell you that I am not an agricultural expert, and I need also not apologise to you for this. But the fact that I was a Revenue Officer for the past 15 years may perhaps confer on me a claim to just say a few words as a preliminary to what I hope will be an interesting and instructive discussion.

It would perhaps be better if I confined myself to the practical aspect of the question and presented before you certain issues which may profitably be discussed.

There are two aspects to this question. The one is the wider outlook of a general economic survey and the other of a purely agricultural enquiry.

As the President of our Union remarked in his opening address yesterday, the subject of a survey of the Economic Condition of the Agriculturist is of paramount importance and it behoves us all to bestow our immediate attention to this work.

One of the ways in which this could be effected is by the members of the Union both official and non-official taking up some typical village of manageable proportions in their neighbourhood, and studying the economic condition of each family first-hand. This work is interesting and can be undertaken as a piece of diversion during leisure hours.

Such enquiries have been instituted in other parts of India by public-spirited gentlemen. As an instance, I may mention the name of Mr. A. P. Patrao of Berhampur. And it is perhaps needless for me to invite your attention to that admirable book by Dr. Mann, giving the general economic survey of a Deccan Agricultural Village near Kirkee.

Although we cannot all hold such informing or elaborate enquiries as are contained in Dr. Mann's book which by the way embodies the results of the labours of a number of co-adjutors who have been severally responsible for the several chapters of the book, we may perhaps proceed on less ambitious lines.

I have myself during my tours as a Revenue Officer tried to take the ryots into my confidence and to elicit some useful information with regard to their actual conditions. This I used to do to find out their indebtedness.

It should be possible for us to know some details under certain broad heads, such as the number of people in the family, the extent of land owned and cultivated under wet, garden and dry, the yield under each head, the number of livestock, their probable market value, and any other source of property or income, and on the expenditure side, we may ascertain the expenses of cultivation, the assessment paid to Government, the cost of the upkeep of the family, including cost of education and clothing and any special charges, such as for marriage, sickness, etc., and also interest paid, if any, on previous debts. After collecting these figures, it should be quite easy to find out whether the family budget shows a minus or plus balance.

In my experience I have found that about nearly 70% of the families investigated were economically unsound. I happen to speak this from memory. I believe this may be correct. This view was confirmed by a study of the figures which I had to collaborate in connection with the Special Debt Survey of two Hoblis in the Sagar and Nagar Taluks ordered by Government on the recommendation of the Malnad Improvement Committee of Shimoga and conducted under the advice and guidance of the Registrar of Co-operative Societies. It was also a very remarkable coincidence that the general results with regard to economically sound and unsound families were found to roughly correspond with the percentages arrived at in Dr. Mann's publication referred to above.

As a sort of guide for such enquiries, I would commend to your attention the form prescribed by the Registrar for the Malnad Debt Survey. A copy of this form is now before you. It is fairly comprehensive and practically covers the ground in so far as our needs are concerned.

Family as the Unit of Enquiry.

1. Name of head of family
   Age
   Place of birth
   Occupation
   Members of the family : whether male or female, whether dependants or earners
   Literate or not
   How many rooms in the house
   General health of the family

2. The total worth of the family :—
   (*a*) Lands—DRY, WET, GARDEN, Assessment
   (*b*) Houses
   (*c*) Cattle
   (*d*) Carts, ploughs and implements
   (*e*) Stock of grain, fodder and manure (for house use or sale)
   (*f*) Jewellery
   (*g*) Money-lending
   (*h*) Miscellaneous

   Total ..

3. TOTAL INCOME OF THE FAMILY :—
   (*a*) *Major income*—
      (i) Kandies of crop, dry, wet, garden, value
      (ii) Straw and grass harvested
      (iii) Interest by lending. How much ?
   (*b*) *Miscellaneous income.*
      (i) By sale of milk, butter, firewood, etc.
      (ii) By cooli work
      (iii) By home industries, *viz.*, weaving, carpentry, smithy, washing, cattle and sheep-rearing, etc.

   Total income of (*a*) & (*b*) ..

4. TOTAL EXPENDITURE OF THE FAMILY :—
   (i) Household expenses, such as food, etc.
   (ii) Clothing
   (iii) Jewellery
   (iv) Religious and other ceremonies
   (v) Education
   (vi) Medical aid
   (vii) Government assessment
   (viii) Expenses of cultivation
   (ix) Interest on loans borrowed and repayment of loan, if any
   (x) Any other item

   Total expenditure ..

5. Whether indebted or not ? To what extent ? At what rates of interest ? Are there any onerous conditions attached, *e.g.*, that the produce raised by the borrower should be sold to the lender ? Why was the loan raised, from whom, for what period has it been continuing ?

6. Is the interest and instalment of loan paid regularly? If not, why?
7. How much loan is required for completely discharging old debts and for what period?
8. What is the security available?
9. Any possible scope for increasing the income or saving in expenditure?

Coming next to the other aspect which in my opinion is perhaps more legitimate to the purpose which the Union has in view, I mean, a purely agricultural enquiry, it has to be admitted that this is a matter mainly for official agency. But there is perhaps no harm in referring to its scope and the methods at present employed and suggesting any measures to improve them.

It is admitted that "the final object of such an agricultural enquiry, including in the term the collection of agricultural statistics, should be to urge through its means as a practical outcome of its results, the policy of maintaining agricultural operations at the highest attainable standard of efficiency."

Naturally therefore arises the question whether the existing practice is calculated to achieve this object.

The system as at present obtains is for the Shanbhogue of the village to submit certain essential returns. These are so well known to all of us that I need not go into the details. These figures are compiled in the Taluk Office and District figures are furnished to the Revenue Commissioner who publishes the Season and Crop Report.

There are, of course, separate statements compiled for livestock. But the agency for collecting and compiling all these figures is the Revenue Department.

It is now a point for consideration whether the Department of Agriculture should not be brought into closer touch with this work, and the compilation of the figures for the whole State should not be entrusted to the Director of Agriculture as he is responsible for devising measures to improve the methods of agriculture, and he can do this better by having timely access to the District figures first-hand and by studying the same while compiling them and reviewing them for public information.

Is it again necessary for the District figures to pass through any Agricultural Officer, such as the Divisional Officer, or would it

not be better for these figures to come direct to the Director since there is no Agricultural Officer for each District and there is therefore a chance of needless delay.

Then again, the Union may perhaps discuss whether a review of the Agricultural Statistics of each District should not be separately published, so that a really useful and correct idea may be formed of the improvement or the agricultural efficiency of the particular District.

These issues, I leave to the members of this Union to discuss. I take it that we are not precluded from formulating our own opinions on these vital matters and placing them before the authorities for such use as they may think best to make. The issues are fairly important and they demand the earnest attention of everybody interested in the agricultural advancement of our State.

The Mechanical Constitution of Soils as affecting the Outturn of Crops.*

BY

Mr. H. Sreenivasa Rao,

Retired Deputy Conservator of Forests, Mysore State.

THE attention of those working for agricultural improvement is mostly confined to the introduction of improved implements of tillage, new and better varieties of crops and to manures, etc. The improvement of the mechanical constitution of the soil which is very necessary for increasing the outturn of grain crops has not as yet received the attention it deserves. The physical condition of soils greatly varies in one and the same village and there are great many variations over the entire area of the State. The surface of the whole country is of an undulating nature giving rise to numerous ridges and valleys. In the elevated portions out-crops of solid rocks are often met with which in some places rise to great heights often forming long hill ranges. In all localities farther removed from these hilly out-crops the undulations are gentler while they are more pro-

* Paper read at the Annual General Meeting of the Union, November 1920.

nounced nearer them. Traversing the country from West to East we find the Western border towards the ghats more undulating than the Eastern portions. In the black cotton soil areas the surface undulations are much less visible so that in greater portions they appear to be almost flat. Between steeps of the ghats and the flats of the black cotton areas various gradients are to be seen. Owing to the waving surfaces, cultivation is chiefly confined to valley portions and to the lower and middle slopes. The gentler the gradient the farther up the slopes does the cultivation extend. Generally the lower portions of the valleys are apportioned for wet and garden crops and the upper portions for dry crops.

2. In every village the low lying lands have been longest under cultivation and the later extensions have progressed from bottom upwards the slopes. The dry fields situated as they are on the sloping ground are subject to a physical change and unless measures are taken to counteract this, these soils must grow poorer every year. The land is subject to torrential rains many times in a year and the water from the higher portions rushes down freely over the fields carrying away with it fine particles of the soil which is finally deposited as silt in the tank beds or is carried of into streams. The loss of silt is the greatest if subjected to washing when the soil is in a state of tilth. In the Kolar District (where the soils have been derived mostly from the gneissic rock) the prevailing soils are generally red loams with a large percentage of sand and the dry fields lying as they are on sloping ground have been subjected to the washing effects of rain for long years and the effect of this washing is clearly seen in the low lying fields which have been longest under cultivation. Greater portion of the finer particles of the soil *i.e.*, the clayey portion has been washed away leaving behind the coarser and heavier particles of sand. For this reason soils which were once loamy have now become sandy loams or even loamy sands. When we know the functions of the three mechanical constituents of the soils, *viz.*, sand, clay and organic matter, we need not wonder why our dry fields have become poor. Clay is the holder or carrier of all plant food ingredients while sand is useful only to open up the soil for the free circulation of air and moisture and to make tillage operations easy. Knowing the purposes which each serves, any reduction of clay

beyond a definite proportion (which is different for different crops) may be deemed as a proportionate loss of the fertilizing matter of the soil from which that ingredient has been carried away as silt. This change from a loamy to a sandy condition is observable in every village in the Eastern Districts and in consequence, I am of opinion, the outturn is falling gradually except in fields to which silt and liberal quantities of manures are being applied.

3. To give you a practical instance of this fact, I lay before you the results of an examination made by me in my village which is one of the typical instances of this kind. My family owns a field which is 4 acres and 5 guntas in extent. This has been continuously under Ragi cultivation for over 50 years as I know (not to speak of the period before my boyhood). This field is cultivated by a ryot on *waram* tenure and it is not much to the tenant's interest to manure it heavily or apply tank silt or fresh earth. He applies cattle manure at the rate of 10 cart-loads per acre and cultivates it as he does his own fields. In the early seventies when I was in my teens I was often sent by my elders to measure the produce when harvested and I remember well having measured once 24 candies. Once or twice in the eighties I remember having measured 18 and 20 candies and then a few years after, 14 candies. For the last 16 years, that is from 1904 till now, this field has been producing on an average only five and a half or 6 candies and the yield is said to vary from 3 to 8 or 9 candies (in unfavourable and favourable seasons respectively). This gives an average of $1\frac{1}{2}$ candies per acre or 270 seers. After many years of absence from the place I was surprised to learn about two years ago that the yield was very poor and I wanted to find the reason for this fall. On a visit to this spot I found the soil to be more sandy than before and I guessed that this may have something to do with the falling outturn (apart from manuring which is more important than all). In order to test the approximate composition of the soil I took a small quantity of it from a depth $\frac{1}{2}$ an inch below surface and on analysing found it to consist of 9·6 per cent of clay, 89·2 per cent of sand and 1·2 per cent of organic matter. The sand and clay are so disproportionate and organic matter so small that no better results could be expected. The proportion of sand has much increased in the top layer ploughed annually owing to washing effects of rain and the finer particles of clay washed down from it has

silted up the tanks. With the increased proportion of sand not only the fertility has fallen but the soil has become incapable of retaining the effects of manure for more than about a season so that a portion of the manure applied is also wasted. With a view to obtain the comparative view of the compositions and outturns of different fields, another field in the same series but still lower situated was selected for examination. I knew that the owner was applying to it, at least for the ten years, about 45 cart-loads of cattle manure mixed with red loam dug from the side of his manure pit. This gives an average of 13 cart-loads of manure and 13 cart-loads of loam per acre. The results of examination of this soil were as follows :— Clay 12·75 ; sand 81·75 ; Organic matter 5·5. This field which is one acre and thirty guntas in extent is annually yielding 10 to 12 candies of ragi as the owner admits, *i.e.*, about 6 candies (of 180 seers) per acre. The results of these examinations confirm my suspicion that manure, irrigation and cultural operations being the same, the yield varies according to the proportion of the physical constituents of the soil beyond a fixed normal and soil with a disproportionately large quantity of sand gives a smaller outturn than one in which sand is proportionate. With a view to investigating further the truth or otherwise of this I selected about half a dozen well-experienced ryots and questioned them each separately. They are all unanimously of the opinion that the outturn is heavier in soils situated higher up the slopes which came under cultivation long after the two fields mentioned above and are still of a more loamy character compared to them. They also stated that in spite of uniform manuring and good seasonal conditions the outturn of sandy loams shows a tendency to fall except those to which fresh red loam and tank silt are being applied. They say that the fields to which silt is being applied with manure are improving with each application though silt by itself is not so beneficial especially in the first year of application. The gradual decrease in yield is the general experience of the ryots all over, but few people have thought about the cause. Some attribute it entirely to decreased or irregular rainfall and others to ill-luck or bad times and so on. My observations extending over 5 or 6 years in various places force me to conclude that one of the causes of exhaustion of dry lands is the annually increasing percentage of sand and the accuracy of my opinion was

further confirmed by the experience of others as stated above.

4. The exhaustion due to washing must be proportionate to the length of the period of cultivation, the gradient of the field, the quantity of rain water which washes the surface and the nature of the showers *i.e.*, whether drizzling or heavy. Much may be done to minimise this exhaustion by laying out the fields in a convenient manner. As the boundaries of fields are all marked by low bunds, generally the rain water falling on a field has to flow down over its surface. If the length of the field follows the slope, the exhaustion is more rapid. To check this a number of cross bunds at short distances will be of use as these divide the field into terraces and break the rapidity of flow. These cross bunds also detain part of the silt brought down from places higher up. It is advisable to make the fields stretch along contours and to make cross bunds as above even on mild slopes to check the flow. The effect of washing is not quickly noticed in flat soils or where rainfall is less or showers gentle so as to allow the rain water to soak into the soil instead of rapidly flowing over its surface.

5. As the situation of the fields already in existence could not be changed owing to their being numerous petty holdings and aversion to exchange, their condition can only improve by resorting to cross bunds as above. The only way to improve soils rendered less fertile by washing is to add on fresh loam or still better tank silt free from injurious compounds.

6. To illustrate the value of adding fresh earth or silt I invite attention to the average difference in yield of 4½ candies per acre between the two fields compared. The difference is very remarkable. It may be attributed to the heavy manuring of the second or richer field which gets 3 or 4 cart-loads more than the other per acre. If the increase is due to manure alone it would be reasonable to expect an increase proportionate to the increased quantity of manure applied which is about 4 cart-loads. The increase due to this excess quantity of manure would therefore be about 3-5 of a candy which added to the average yield of the first field gives about 12-10 candies per acre, but even this is still short of the second or richer by nearly 4 candies. Making a further allowance of 12-10 of a candy for error, etc., there still remains an excess of two candies in favour of the second field which wholly or in part is due

to the beneficial effects of fresh earth or silt added, as the material applied always contains a larger proportion of finer particles or clayey stuff than that to which it is added. By clay I do not mean pure clay of chemistry but clay carrying or holding in it various salts and other mineral compounds as also finer particles of organic matter both in soluble and insoluble conditions.

7. Ryots have practical experience of agricultural matters within their narrow sphere and if they found no advantage in applying fresh earth or silt they would be the last men to do it. But as matters stand many intelligent ryots have taken to applying tank silt to their exhausted fields and are getting higher returns by this practice. I wish the members of this Union would take up this question earnestly if they wish to enhance the land produce. If cattle manure and silt were applied to the soil each separately and mixed the beneficial results would not follow so quickly as if both were mixed and applied. Hence experienced ryots cart the silt to manure pits and keep mixing them by turning up 2 or 3 times. The extra beneficial result of this process seems to arise in the following manner. If cattle manure and silt can each add to the soil X and Y quantities of fertile ingredient when applied separately the application of a compost made of both some time before is likely to add X+Y+Z quantity of plant food in as much as the decomposing organic matter of the cattle manure acts immediately on the silt and brings a portion of the dormant plant food into a soluble condition.

8. The increased proportion of clay serves two useful purposes, *viz.*, (1) it supplies more mineral plant food to crops, and (2) it keeps the effect of manures applied for long so that even small quantities applied will produce better results than in soil where sand predominates. It is true that when heavily manured even sandy soils give high returns but it is no economy to do so as its effects do not last long. The only disadvantage of applying silt is that it makes the soil stiff rendering tillage operations difficult and also curtailing the period of tillage operations to some extent. But these are unimportant items compared to the benefits of increased outturn which is the main object of all agricultural operations. Besides this, Ragi produce in fields which have a larger percentage of clay is more glutinous than that grown in sandy soils and it is said to weigh more bulk for bulk compared to the produce of sandy soils.

9. In order to secure the largest yield consistent with least possible difficulties of cultivation, I think, soils containing a definite proportion of clay, sand and organic matters are required. This proportion has to be found out by experiments. I beg to suggest to you, gentlemen, to find out the most profitable mechanical composition of soils fit for ragi, paddy and jolam which are the staple food crops of the country. This may be done by taking up in one and the same place equal plots in soils having different mechanical composition and to put them under crops after applying equal quantities of the same kind of manure. First of all, experiments may be carried on in pots and the results obtained thereby confirmed by field experiments on a large scale.

NOTES AND COMMENTS.

By the Editor.

A Query Column in the Journal.

As it has been decided at the last Annual General Meeting of the Union that a "Query" column should be opened in the Journal, we invite readers to take advantage of this new feature. Every attempt will be made to furnish prompt and accurate answers through the pages of the Journal.

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Electro-Culture.

We invite the attention of readers to the article on this subject appearing among our "Selections" in this number of the Journal. It is a comprehensive review of the history and the present state of knowledge regarding this new and fascinating subject and in a State like ours with its cheap hydro-electric Power should reveal to many a thoughtful mind possibilities of useful application.

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Concession regarding Honge (Pongamia glabra) Leaves and Seeds.

Our ryots will appreciate the recent concession sanctioned by Government in this regard by excluding "Honge" leaves and seeds from the list of "Minor forest produce". The order runs as follows : "It is desirable in the interest of the agricultural population to exclude both Honge seeds and leaves from the category minor forest produce. They should be sold in future as an independent item by the Forest Department preferably to ryots."

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The Vth Quinquennial Cattle Census of Mysore.

It has been ordered by Government that the Fifth Quinquennial Cattle Census of the State should be taken along with the ensuing preliminary General Census so that the enumerators and supervisors employed for the general census may be available for the work also thereby securing without much additional cost more correct statistics than could be collected through the ordinary village agency.

The Annual Meeting of the Union for the year 1920.

The Annual Meeting of the Union for the year 1920 was held in the month of November. It was a very successful session. A large number of members attended including many from the districts. A number of papers were read ; the discussions were lively and informing ; several important resolutions were adopted ; programmes of work for the ensuing year were drawn up and the usual visits were paid to the Farms and Laboratories. Members will receive printed copies of the proceedings in which a full summary appears, along with the current number of the Journal. The papers contributed to the session are being published separately in the Journal.

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An Agricultural Lecturing Tour.

The Staff and Students of the National Agricultural College at Adyar have arranged for a lecturing tour through certain Districts of the Madras Presidency to enlighten ryots on improved methods of Agriculture, rural life, agricultural co-operation and the like subjects. Many of the Madras firms have, it is reported, promised assistance both financially and by the lending of implements and agricultural appliances in which they may be interested. The magic lantern is to be freely used illustrating agricultural scenes and methods both in India and abroad and demonstrations and an exhibition of specimens and produce are to be other features. The Caravan will be in fact a moving agricultural exhibition something similar but in a small way to the "Better Farming trains" organized by Canada and the United States of America in connection with Agricultural extension work there, a description of which appeared among our selections in Vol. I, No. 3, of this Journal.

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The New Agricultural Faculty at the Benares Hindu University.

The Hindu University of Benares is starting its Agricultural Faculty under splendid auspices. We read that His Highness the Maharaja of Benares that open-handed benefactor of the University has handed over an area of 2,100 acres close to the University site and apparently capable of being irrigated from the Ganges for the purpose of a Farm on a permanent lease. Two lakhs of rupees have

been the equally princely donation of Rai Ganga Ram Bahadur, one lakh being for the Agricultural College and one lakh for a canal to be brought from the Ganges into the extensive area of the Farm and the University grounds. The ceremony of cutting the first sod for the canal which is to be a mile long and 100 feet broad at the bottom and 7 feet deep was performed most appropriately by His Highness the Maharaja of Benares himself on the 14th December 1920, in the presence of a distinguished gathering which included M. Clemenceau. We have no doubt further benefaction will be stimulated and that the University will soon possess one of the best equipped Agricultural Colleges in India.

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Is it advantageous to milk thrice daily ?

The Agricultural Gazette of Canada reports that it has been the experience of certain dairy farmers that high producing cows can be induced to give more milk if milked thrice daily instead of only twice. Some of the Experiment Stations have been testing the correctness of this point, and though their experiments do not give conclusive results yet some of the stations have obtained results which go to show that in the case of cow's giving 60 lbs. and more per day it will be profitable from the standpoint of both economy and safety to milk them thrice a day. One result extracted in the Gazette gives figures to show a drop of 9 to 10 lbs. a day when cows which were milked thrice a day were changed to the twice a day milking system. Another experiment carried through a longer period of time than the above showed difference which could not be put down merely to the change in the frequency of the milkings. The general consensus of opinion seems to be that it will be well if cows giving more than 60 lbs. be milked thrice a day, and in the case of cows yielding less, when there is a tendency for an over distended udder.

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The admission of Indian Students into Colleges in Australia.

We have to be thankful to Professor J. Saunders, M.A., of the American College, Madura, who, during a period of leave which he spent in Australia, took pains to definitely ascertain the position regarding the conditions under which natives of India could enter that country. We are informed that the Australian Government have

relaxed their former rules and now permit natives of India desirous of visiting Australia for the purpose for study, trade or travel to proceed to and reside in that country without any restrictions as to the period of time they may choose to reside. Visitors should however provide themselves with a passport stating the capacity *i.e.*, student, trader or tourist, in which they wish to proceed to Australia and signed by a competent Officer of the Government in India; residence for an indefinite period will likewise be subject to the condition that visitors continue in the capacity in which they were admitted into the country.

Professor Saunders also interviewed many educational authorities including the heads of technical colleges and states that the Colleges would be very glad to admit Indian Students.

* * * * * *

Synthetic Ammonia or the Fixation of Atmospheric Nitrogen.

Accounts are published of a French invention by which the production of Ammonia by the combination of atmospheric Nitrogen with Hydrogen by what is known as the German Haber process has been greatly simplified and rendered incomparably more efficient. It is claimed for the new process that whereas by the Haber process only 10 to 12 per cent of Nitrogen and Hydrogen was converted into ammonia, this proportion is more than tripled by the new process. Further on account of the enormous pressure of 900 atmospheres brought to bear on the mixture the apparatus occupies very much less space and the ammonia itself is obtained in the liquid form. At present the inventor has been realizing a daily output of a ton and a half of ammonia corresponding to seven tons of sulphate of ammonia with a plant and works thirty times smaller than would be required by the Haber process for the same quantity of Sulphate of Ammonia.

The value of this invention to agriculture is incalculable; the bogey of nitrogen famine raised by the late Sir William Crookes with the steady and growing depletion of the Chillian Nitrate deposits, should soon be laid.

* * * * * *

Increasing the World's Cotton Supply.

We read that the Government of French Indo-China is working on a comprehensive scheme of irrigation and other projects to extend

cotton growing in the plains of the Mekong River. Already we are told that the annual production is about 25,000,000 lbs. of cotton that the quality is superior to that of Indian cotton, and that it fetches a higher price in the Hongkong market.

We also read that cotton as an irrigated crop is being taken up extensively in Southern California in the Imperial River Valley where yields of over 2,000 lbs. per acre of Egyptian cotton are being obtained and this variety is to be put down to the exclusion of the local Upland cottons. Travelling through these regions some ten years ago and visiting the various Agricultural Experimental Stations in the dry States of the Southern United States of America, we were struck with the possibility of irrigated cultivation in these tracts where cotton of many varieties was already being experimented with in the different Experimental Stations and also grown on a fairly large scale in Southern California. The world is by no means at the end of its resources in regard to the supply of cotton as some writers would have us suppose.

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Canada follows Indian Example—
Revised Courses in the Ontario Agricultural College.

In our Notes in Vol. II, No. 2, of this Journal, we drew attention to the revised courses of instruction both in our local Agricultural School and in the College of Agriculture at Coimbatore. It may be remembered that the change was designed with a view to serve two distinct functions of an Agricultural school, the one to train men who will be well qualified to take up responsible positions in the Department of Agriculture or other kindred institutions and the other, to train men in better methods of farming with such grounding in the theory underlying practice as may be necessary to make them follow their work with understanding. We are glad to read that a similar change has been deemed necessary in one of the best of Western Agricultural Colleges *viz.*, the Ontario Agricultural College, Canada.

In the old arrangement the two years' course taken by the lower (*i.e.*, Diploma) class was identical with the first two years of the four years' course taken by the (B.S.A.) degree class and candidates for neither course need have matriculated. In the new arrangement

the Degree course of four years is quite separate from the Diploma or lower course while, further, matriculation standing will be insisted on for the higher course men. One of the reasons given is "Ontario needs not only first class farmers, but first class Agriculturists, and the best way to get first class Agriculturists is to have them trained in Ontario and not imported from some of the other Provinces, the United States of America or Great Britain," with which we would request readers to compare our own comments, for they are exactly identical.

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Three acres and a Well.

Have we exhausted the possibilities of well cultivation in the State? By no means, we should think. Much has been done no doubt in the past and in various parts of the State notably in the regions of precarious rainfall. In the extreme Eastern taluks of the State many large and substantial irrigation wells can be seen. In other taluks notably Hoskote, Chikkaballapur, Devanhalli and Sidlaghatta numerous irrigation wells exist which, though merely holes sunk in the firm laterite mud and very insignificant compared with the fine large structures of the former class, still make up in importance by this large number. Most gardens under tanks possess wells, as likewise wet lands on which sugarcane is grown in many cases. Nevertheless knowing what we do of the conditions in the State we are of opinion that the scope for expansion is great and the need for it is greater still.

In years of favourable rainfall the areas under well cultivation afford scope for the growing of the money crops like sugarcane, onions, garlic, potatoes, tobacco, chillies and the like; and in the neighbourhood of towns crops like the different vegetables, flowers, etc. These areas are most intensively and most intelligently cultivated as a rule; the land is almost invariably fenced, which enables the farmer to be independent of village custom as regards the selection of the crops to grow or the season to plant and reap; crops are grown all through the year, the farmer often has a farm house on the land itself with all the advantages the land derives from such a system; the farm cattle are always looked after better, there is an intelligent and comparatively economical use of irrigation water,

there are always a few fruit or flower plants or shade trees and altogether there is a general aspect of comfort and thrift which one rarely comes across even in the areas considered the most valuable such as say under the river channels.

In the years of ordinary rainfall or of drought the value of these can hardly be overestimated. An acre or so of grain crop can always be raised to maturity which may to a poor family mean a great deal but what is more important is the possibility of raising some amount of fodder for the cattle. Grain at least can be imported, for, thanks to railway and steamship transport the State is able to arrange for a supply of grain in the markets. Even in very bad years and provided there is money to buy, the ryot can always procure enough. It is different, however, with cattle ; even in normal years the majority of the village cattle do not have enough ; from February to August of each year they live anyhow in a state of semi-starvation, recovering again only during the remaining half year. In years of drought the cattle mortality becomes serious and ryots have great difficulty in keeping even their best cattle alive and the best efforts of Government do not avail to obtain supplies of fodder. It is here that the greatest value of these wells comes in. Even if these wells should not be spring wells but only percolation wells such as may be excavated both in the catchment of tanks and below them in the wet land, the fact that they retain water for quite a time after the tanks dry will make them of considerable use both in good and bad years. These wells are generally cheap to construct and their great value in keeping alive a crop which otherwise would have perished with the drying up of the tank, and in other cases in enabling the farmer to plant crops early so that they make some growth before the rains commence is known in many villages. Wells, be they of the substantial or of the subsidiary type, are the cheapest form of insurance against drought, besides being in good years the source of great profit and the cause of much high class and thrifty farming. Three acres and a well would be an excellent ideal for every farmer to keep in view ; we may also refer to the liberal terms on which *takkavi* loans can be obtained from Government, both in the rate of interest and in the means of repayment and would urge our farmers to avail themselves of this concession to a much larger extent than they have been doing in the past.

SELECTIONS.

I

Benefits of Crop Rotation.

In the matter of crop rotation, the practice can be so carried out that great benefits will result.

Some crops require large amounts of one nutrient, while certain others draw more heavily upon some other ingredient. Thus a rotation of crops is less likely to cause a deficiency of some one constituent than is a continuous growth of one crop. Then again root systems vary in habit of growth and we find some crops deep rooted, some moderately deep, and others shallow. It therefore develops that a proper rotation will draw nutrients from different soil depths and a large area can be utilized more economically. Another notable benefit is that some crops prepare food for other crops as it is illustrated by the power of legumes to leave an increased nitrogen supply in the soil for the succeeding crop. Again some plants throw off toxic substances which, if allowed to accumulate through constant cropping, will prove injurious to the crop. Other reasons which can be advanced for crop rotation are that crops differ in their effect upon soil structure–some prove more valuable than others in altering the physical condition ; certain crops check certain weeds, while others check diseases and insects and finally a system of crop rotation permits a more constant use of the land than is possible with most annual crops, and since unused land loses more plant food than cropped land it is possible by rotating to save plant food that would otherwise be lost. In all grain farming one should closely adhere to the practice of returning to the soil all crop residues except the grain and seed.—*Plow and Tractor, Vol.* 5, *No.* 4.

II

A New Method of Growing Potatoes.

An American way of growing potatoes may be worth trying in this country. The " seed" is not planted in soil at all. The ground is dug lightly, and it is then covered with several inches of straw, or any fairly dry litter. " The seed" is placed in the straw and covered with a further layer. The straw is kept just a little moist with water, and the planted potatoes soon begin to grow. The roots travel rapidly downwards

through the straw to the soil, but the production of tubers goes on exclu sively in the straw, and those produced are exceptionally large ; moreover, they are three weeks or a month ahead of those grown in the usual way. Potatoes thus grown may be easily gathered without disturbing the plant as a whole. The hand is thrust down into the straw and the largest potatoes that can be found are pulled away. The smaller ones are allowed to remain until they grow to a good size. It is claimed that by gathering potatoes in this manner the yield of any one plant is almost doubled.—*The Jayaji Pratap. August* 12, 1920.

III

Better than Book Farming.

Teaching agriculture from a text-book is a remnant of the earlier method in the development of agricultural education, as tried in the public schools. In Ontario, between the years 1845 and 1898, four different text-books were used. At present there is no prescribed text-book in agriculture in that province. Not that the printed word as a means of enlightening the mind is ignored. But for young pupils in elementary schools, the primer in agriculture is the book that lies open in every country child's everyday observation and experience. The book is the Book of Nature as found in the farm. The teacher of agriculture directs the learner to that book, and helps him to read it. He learns, from his teacher just as a farm child, in a good home, with an intelligent father and mother, lessons in agriculture and in everyday life. It is a natural method of teaching and learning agriculture. It awakens an interest, it trains the powers of observation, it leads to inquiries and experiments ; and the trained teacher, who is the chief guide in the intellectual development of the child, uses these experiments as the solid ground-work for her building. She goes further in teaching agriculture than any home can.

The pupil seeks the help of books, but he is not primarily dependent on books. There is created in him a taste for reading, and his reading is directed intelligently. But the method doesn't make " book farmers " ; it makes interested intelligent reading farmers. Moreover, the book is not discarded, but given a place of honour ; every country school should have its agricultural book-shelf.

IV

Utilizing Prickly-pear.

A South African, recommending the use of prickly-pear as a cattle fodder in drought time, says : " There is no need to wait or worry for a way to get rid of the thorn. Singing, rubbing, etc., have been practised, but there is a ridiculously simple plan. Just buy one of the turnip or mangold pulpers commonly in use in England and 3 H. P. oil or steam engine, and put the whole lot through it. The small spines (hairs), which are most irritating, are rendered innocuous by the juice. The large thorns which are more dangerous because of their hard, brittle points, are invariably topped and blunted on the journey through the machine and are greatly influenced by the slimy liquid. You can wash your hands or face in the pulp as it comes from the machine without the risk of finding a single spine."

" Five per cent weight of crushed grain or meal, or more of bran, will make a good dairy feed or pig feed at any time, but not a balanced ration. It is unsurpassable. Some farmers use it drought or no drought and claim for it high milk-producing properties. I cannot guarantee that but the rest is personal experience.

" Another tip. One sliced leaf, left to bleed for an hour or so in a four-gallon tin of whitewash, will cause the latter to stick on walls or fruit trees almost like paint."—*Pastoral Review, Vol. XXX, No.* 5.

V

Coffee Substitutes.

A writer in the Tea and Coffee Trade Journal says that the American Department of Agriculture has just issued a warning to buyers about some so-called coffee beans which have been exploited recently by extravagant statements in advertisements under the names of the"South American Coffee Bean" and the " New Coffee Bean". The former is the jack bean, and the latter the soy bean. Both are well known plants, and there is no justification, says the Department, either for extravagant advertising claims under new names or for exorbitant prices for seeds.

The use of the seeds of various legumes and cereals as coffee substitutes is not new. A few, especially the soy bean, possess some merit as coffee substitutes, but the desirability of any is a matter of individual taste, says the Department.

The soy bean, almost since its introduction into America, has been exploited at different times as "Coffee Berry", "Coffee Bean", "New

Coffee Plant", "Domestic Coffee Berry," and "New Domestic Coffee Berry". For many years it has been used to a slight extent in Europe, especially Switzerland, as a substitute for coffee. In Japan and Southern Russia the soy bean is prepared as a coffee substitute and placed on the market. This product is ground very fine, and has much the same appearance as coffee.

For those who desire a substitute for coffee as a drink, the dry beans of any variety of soy bean, when properly roasted and prepared, may be used. Prepared as coffee, the soy bean gives a liquid which, in colour and aroma, is similar to coffee but it has no stimulating effect. Many people who can tolerate cereal drinks think the soy bean fully equal to the cereal coffee substitutes.

The use of the jack bean for "near coffee" is not a new thing and its merit for this purpose is no greater than that of many other beans. For forage the jack bean is not equal to the soy bean, velvet bean, or cowpea, and thus far it has not shown that it is of any particular value in American Agriculture.—*Indian Scientific Agriculturist, May* 1920, *Vol.* 1, *No.* 6.

VI

Sunflower Silage for Dairy Cows.

The giant sunflower of Russia, sown at the Montana Agricultural Station in the Spring of 1915, yielded, when irrigated, 36 tons per acre of green fodder which, when fed to dairy cows, either simply chopped or siloed, gave excellent results. The following year sunflowers, hoed but not irrigated, yielded 22 tons per acre of green fodder. The cows ate from 40lb. to 90lb. a day of young sunflower (representing about 5 per cent of the plant in flower) which proved to have a food value almost equal to that of maize fodder. To determine the food value of siloed sunflower two lots of 7 cows were subjected to feeding tests. Lot 1 received concentrates (oats, malt sprouts and bran in the ratio 5 : 2 : 3) and alsike clover hay. Lot 2 received the same ration except that part of the clover hay was replaced by siloed sunflower. At the end of 28 days the rations of the two lots were reversed and the experiments continued for a further 28 days. The results obtained were :—

	Lot 1	Lot 2
	lbs.	lbs.
Initial average weight	1,072	1,081
Final average weight	1,083	1,087
Average gain in 28 days	11	6

	Lot 1	Lot 2
Average daily consumption :—	lbs.	lbs.
Of concentrates	13	13
Of clover hay	21	12
Of sunflower silage	..	34
Average daily milk yield per cow	33·37	34·35
Average daily fat content of milk per cow ..	1·382	1·459

Thus, a daily consumption of 3¾lbs. of sunflower silage resulted in a saving of 1 lb. of clover hay, and, at the same time, increased the milk and butter yields. The products had no peculiar taste or smell.—*Bulletin* 118, *University of Montana Agricultural Experiment Station.*

VII

Note on the Conservation of Cattle Urine.

H. C. Sampson, B.Sc.,

Deputy Director of Agriculture.

Experiments have been made by the Agricultural Department of the Central Provinces to test the value of cattle urine as a manure. This has been found to be of very great value, and under certain conditions the urine collected from one bullock has been found to be of greater value than the dung of the same animal collected during the same period.

The following is the method of conserving cattle urine as adopted in the trials above referred to :—

"On the floor of the cattle sheds spread 6 inches of fine dry earth kept in position by means of a plank of wood of the same depth. The earth absorbs the urine and retains the nitrogen, and is, therefore, a most valuable manure. The surface of this layer of earth should be kept loose and powdery by stirring it daily with a *mammotie* or other tool. The earth should be stored in a pit or spread in the field after it has been allowed to lie for about a month in the stall ; a fresh layer should then be put into the stalls."

Some modification of this system seems quite capable of easy adoption in this Presidency. Such a system, if adopted, should add much to the comfort of the ryots of the Ceded Districts, and in other places where cattle are kept in the dwelling-house. An adoption of this method would mean a clean and odourless floor and better health both to the people and to the cattle, while in return for the extra trouble a valuable manure is obtained.

On the West Coast, there is, in the South Kanara District, already an excellent system of preserving both cattle manure and urine. The

floor of the cattle-shed resembles a pit some three feet deep. The dung is not removed from this, but is covered over daily with fresh jungle leaves and other fresh vegetable matter. This operation continues until the pit is full when the whole is emptied and either taken to the field or stored in a neatly made manure heap. It would be difficult to improve on this method, provided that the supply of jungle leaves is available, but in many cases this is not the case, and though it may be possible to maintain a supply of leaves and other fresh herbage during the rains, in the hot weather months this system of using dry earth as an absorbent for cattle urine might easily be adopted in places where jungle leaves have now been scarce.

In Malabar, where possible, the South Kanara system of using leaves as litter for the cattle should be adopted, but on the Sea Coast where leaves are not available, this dry earth method might be tried. There is great room for improvement in Malabar in the method of dealing with cattle manure. For several months in the year, this is in a semi-liquid condition and subject to all weathers, with the result that the most valuable manurial ingredients are washed away. This could easily be consolidated by mixing with it leaves, twigs, weeds and other vegetable growth which is so luxuriant during and after the monsoon, while the dry earth removed from the shed could be used to cover the dung, and in time it would become more or less incorporated with it.

In Tanjore and many other East Coast Districts one sees that often considerable trouble is taken to house the cattle, but that no attempt at all is made to conserve the urine. This is either allowed to soak into the solid floor of the shed or else is drained off into the village street, where it becomes a public nuisance. This dry earth method of conserving the urine as adopted in the Central Provinces and described above might very well find a place here, and would add much to the ryot's manure supply, and consequently to the yield of his crops.—*Planters' Chronicle, Vol. XI, No.* 24.

VIII

Accessory Food Factors or Vitamines.

Accessory food factors—so called because the foods in which they are present contain them only in minute amounts—play a prominent part in nutrition, since, if these minute amounts are removed from natural foods, such foods fail to maintain healthy nutrition, and grave symptoms of actual disease may supervene. Among the diseases which have definitely been shown to be produced by the absence of these factors are

scurvy, rickets and beri-beri. Research suggests that the nature of vitamines is quite distinct from that of proteins or of foods which supply energy, but at present we have no knowledge concerning their actual chemical nature. It is thought they may either (*a*) be structural components of living tissues of which a supply is essential, though quantitively unimportant, or (*b*) that they may act rather as catalysts in certain normal processes of metabolism. There is evidence to suggest that these accessory food factors are formed only in the tissues of plants, whence they pass into the tissues of herbivorous animals and thus become available for carnivora.

Vitamines are always present in natural foodstuffs as instinctively consumed by men and animals ; broadly speaking, it is safe to say that the individual always finds a sufficient supply of vitamines in his food so long as that food is reasonably varied and has received no artificial or accidental separation into parts, and so long as no destructive influence has been applied to it.

Clear evidence has been obtained of the existence of three accessory food factors :—

(1) *Soluble A Factor.*—This term was given to this factor by American investigators, as it is soluble in fats and accompanies them in the process of isolation from certain food stuffs ; this factor is probably identical with that, the absence of which leads to rickets in young. This factor is in all probability synthesized by the plant, and its primary sources are found in the green leaves of plants and the embryos of certain seeds. Beyond these primary sources the main sources are certain fats of animal origin, such as butter. The distribution of this factor in foods will be found in the Table concluding this account.

The factor is gradually destroyed at 100° C. (the boiling point of of water), and four hours' exposure to that temperature is sufficient to render butter-fat of little greater nutritive value from the standpoint of vitamine supply than an equivalent quantity of lard. The factor is also destroyed during the hardening of oil by the action of hydrogen, a process now widely employed for the preparation of edible fats, such as margarine.

We as yet know nothing definite of the part this factor plays in the nutrition of the body. Storage of the factor appears to be particularly marked in adult animals, and the requirements after maturity is reached are of a smaller order than those of the growing young. Such storage is of considerable importance to the pregnant and nursing mother, for she can provide her young with a high concentration of this factor without immediate dependence upon an external supply.

(2) *Water-soluble B Factor.*—This term is also that of American investigators, this factor being soluble in water ; and it is probably identical with the anti beri-beri and anti-neuritic factor. The primary sources of this factor also are provided by the plant kingdom. It is widely distributed, having been found in all the natural foodstuffs examined, and it apparently exists free in the plant cell. The principal sources have proved to be the seeds of plants and eggs of birds. In cereals the largest deposit is found in the embryo or germ, the bran coming next, while the endosperm is deficient. This fact accounts for outbreaks of the disease beri-beri among peoples existing on a diet of polished rice.

The requirements of the body for this factor are much greater during growth than maturity, and the large deposits in seeds and eggs suggest a due provision made for the wants of the young offspring during the early period of life. It does not seem that the normal animal possesses any large reserve of the water-soluble factor in an available form and while (as in the case of the fat-soluble factor) the quality of the milk of the nursing mother will suffer if her diet becomes deficient in this essential, the adverse effects here are much more rapid owing to the smallness or absence of such reserve supply.

The factor withstands desiccation for long periods of time. Its resistance to heat is also considerable ; destruction takes place very slowly at 100° C. (212° F.), but is much more rapid in the neighbourhood of 120° C. (248° F.). Tinned foods of all descriptions, with but few exceptions, would therefore be deficient in this vitamine.

The distribution of this factor in foods is given in the concluding Table.

(3) *Anti-scorbutic Factor.*—The preceding factors are admittedly indispensable for growth as well as nutrition. The third or anti-scorbutic factor is undoubtedly indispensable for normal nutrition of certain species of animals, but in the light of present knowledge it is difficult to say whether it is indispensable as a component of a normal dietary for growth, because wide variations occur in the requirements of various species for this substance.

This vitamine is necessary in a diet for the prevention of scurvy, and is found in fresh vegetable tissues and (to a much less extent) in fresh animal tissues. Its richest sources are such vegetables as cabbage, swedes, turnips, lettuce, watercress, and such fruits as lemons, oranges, raspberries and tomatoes. Inferior in value are potatoes, carrots, French beans, scarlet runners, beetroot, mangolds and also (contrary to popular belief) lime juice. Potatoes, although classed among the less valuable vegetables as regards anti-scorbutic value, are probably responsible for the preven-

tion of scurvy in Northern countries during the winter, owing to the large quantities which are regularly consumed. Milk and meat possess a definite but low anti-scorbutic value.

This vitamine suffers destruction when the fresh foods containing it are subjected to heat, drying, or other methods of preservation.

All dry foods are deficient in anti-scorbutic properties; such are cereals, pulses, dried vegetables and dried milk.

Tinned vegetables and tinned meat are also deficient in the anti-scorbutic principles. In the case of tinned fruits the acidity of the fruit increases the stability of the vitamine, and prevents to some extent the destruction which would otherwise occur during the sterilization by heat and the subsequent storage.

Distribution of vitamines in foodstuffs.—The table here given shows the distribution of vitamines in the chief foods. The relative values of the foodstuffs are indicated by positive and negative signs. With increased relative value more than one positive sign is employed; a zero indicates the absence of the factor. Absence of a sign does not, however, indicate the absence of the factor.

Classes of Foodstuff.	Fat-soluble A Factor.	Water-soluble B or anti-neuritic (anti beriberi) Factor.	Anti-scorbutic Factor
FATS AND OILS—			
Butter	+ + +	0	
Cream	+ +	0	
Cod-liver oil	+ + +	0	
Olive oil	0		
Coconut oil	0		
Linseed oil	0		
Fish oil, whale oil, herring oil, etc.	+ +		
MEAT, FISH, ETC.—			
Lean meat (beef, mutton, etc.) ..	+	+	+
Fish, white	0	Very slight, if any	
Fish fat (salmon, herring, etc.) ..	+ +	,,	
MILK, CHEESE, ETC.—			
Milk, cow's whole, raw ..	+ +	+	+
,, ,, skim ,, ..	0	+	+
,, ,, dried whole ..	less than + +		less than +
,, condensed, sweetened ..	+	+	,,
Cheese, whole milk	+		
,, skim ,, ...	0		

EGGS.—													
Fresh	..	..	..	+	+		+	+	+	?0			
Dried	..	..	..	+	+		+	+	+	?0			
CEREALS, PULSES, ETC.—													
Wheat, maize, rice, whole grain			..		+			+		0			
„ „ „ germ			..	+	+		+	+	+	0			
„ „ „ bran			..	0				+	+	0			
Linseed, millet			..	+	+			+	+	0			
Dried peas, lentils, etc.			..					+	+	0			
Soy beans, haircot beans			..		+			+	+	0			
Germinated pulses or cereals			..		+			+	+		+	+	
VEGETABLES AND FRUITS—													
Cabbage, fresh, raw		..	..	+	+			+		+	+	+	+
Swede, raw, expressed juice			..							+	+	+	
Carrots, fresh, raw		..	..		+			+			+		
Potatoes, raw ..		..	..		+			+					
Apples	..	..	..								+		
MISCELLANEOUS—													
Yeast, dried	..	..	..		?			+	+	+			

The facts discovered so far are principally concerned with the causes, producing diseases in animals, but there can be no question that further investigations will disclose that vitamines may play a part in the production of animal products (such as meat and milk) for economic purposes generally.—*The Journal of the Ministry of Agriculture, October* 1920.

IX

Trees as Protection against Wind and Erosion.

The importance of conserving the forests still remaining on mountains or hills in these West India Islands, and of the reafforestation of areas denuded of trees, has been pointed out in several previous issues of this Journal. There is another line, however, of what may also be termed reafforestation, which appears worth while bringing to the notice of West Indian land-owners; and that is the more extensive planting of wind-breaks.

A wind-break may be defined as a belt or body of trees which gives protection to growing crops from prevalent or violent winds. This protection from air currents is effected by a timber wind-break in a purely

mechanical way. Its effectiveness depends, therefore, upon the impenetrability of the wind-break. An ordinary row or two of trees does not present an absolute barrier to the wind; a certain amount of air finds its way between the branches and foliage of the trees, so that the movement of air on the leeward side is not completely stopped; it is only greatly reduced. Again as the trees grow older, openings are left between their trunks, and such wind-breaks can only be made efficient by underplanting with trees or shrubs of smaller growth. An ideal wind-break for checking wind currents would be one of central rows of shorter trees, and outside of these still lower bushes. Such a wind-break would have an inclined surface, which would divert the air current upward, and thus relieve the horizontal wind pressure.

It is, of course, difficult to measure in terms of money the value of a wind-break in giving protection to such annual crops as sugar-cane or maize, or to such orchard, crops as limes; but it is stated in Farmers' Bulletin 788 of the United States Department of Agriculture that, where winds are at all frequent, such protection may be quite equal to the rental of the ground occupied by the trees. A case is quoted of a farm in Southern Minnesota, where a wind-break afforded complete protection for a strip about ten rods wide during a wind blowing about fifty miles an hour. On the unprotected part of the field the crop was so damaged as not to produce more than a third of what had been estimated. On the protected portion a full crop was produced from six acres, whereas the wind-break occupied only two acres.

Another benefit derived from wind-breaks is the reduction of evaporation. Anything which helps to conserve the moisture of the soil, especially in dry districts, is of direct benefit to the planter. The bulletin quoted above states that a wind-break has this effect in a marked degree. The drying power of the wind is reduced very nearly in the same proportion as its velocity. In the immediate lee of effective wind-breaks evaporation is reduced as much as 65 per cent. Here in the West Indies, where the trade winds blow with considerable force throughout the growing season, especially at the earlier part of the growth of the cane crop, their drying power is well known to planters, and it would seem important to use means of preventing evaporation.

In an article contributed to the International Sugar Journal, March 1920, on the value of tree planting on sugar estates, Dr. C. A. Barber refers to his experience in the value of wind-breaks at the experimental Sugar Station at Coimbatore in South India. He says that, provided there is plenty of overhead sunlight, the sugar-cane appears to be very

grateful for lateral shade and protection. In the bulletin mentioned above it is stated that corn or maize crops showed more consistent and marked benefit from protection by wind-breaks than any other crops. Fields of young corn showed much better growth in the area protected by and this benefit was still in evidence at the end of the season, the protected area not only producing more fodder, but bigger and heavier ears. With ordinary food crops a benefit may be derived from wind-break protection which will make the loss of the area occupied by the trees negligible.

It must be remarked that the effect of a wind-break on crops is not beneficial in every respect. There are certain ways in which it is evidently injurious. Trees in a wind-break always spread their roots extensively into the adjoining fields in search of moisture ; and they take not only the moisture, but some of the necessary plant food out of the soil. Furthermore, if allowed to spread their boughs too widely by shading the ground, they will prevent crops from developing properly. It would, therefore, be improper to plant trees where their roots interfere with the proper growth of canes or other crops. In this connection it may be observed that the injurious effect of different species differs very greatly. Such trees as the 'Barbabos Evergreen' (*Ficus nitida*) and other allied species, or such trees, as tamarinds, may be instanced as certainly injurious to crops in their neighbourhood, although Dr. Barber states that by digging trenches four feet deep and clearing these once a year, it has been found possible to grow excellent cane crops right up to tamarind trees. The plan of digging a deep trench between the wind-break and the field in which a crop is planted, and the regular cleaning out of such a trench would seem to be the correct method of preventing possible loss from the tree roots, while obtaining the benefit of protection from the wind by the trees. On the other hand, there are many leguminous trees, such as *Albizzia Lebbek* (' women's tongues'), *Pithecolobium Saman* (' Jamaica Shade tree') and various species of cassia ,and aslo such smaller leguminosæ as *Gliricidia maculata*, which have probably a beneficial effect upon the soil.

In some of these islands, where *Lebbek* and *Saman* trees are grown for shade purposes in Guinea grass pastures, it has been remarked that the grass grows luxuriantly right up to the base of the trees.

Other classes of trees, which would probably be of great value in the formation of wind-breaks, are those which themselves produce a remunerative leaf crop, such as camphor and pimento. The systematic pruning of these trees for the sake of their leaves and twigs would keep the wind-break under proper restraint, and also prove a source of profit to the planter.

Apart from the question of what material to use to construct a wind-break, there is another point to be considered, namely, the direction in which the wind-break should be laid out. In the West Indies the answer to this question is simple. Owing to the prevalence of the trade winds, roughly speaking, from east to west, the line of a wind-break should be, also roughly speaking, north to south ; thus the greatest amount of protection for the greater part of the year would be attained.

The foregoing applies strictly to the protection of crops from the wind. If, however, the term wind-break is used in a wider sense, as denoting a continuous belt of trees planted without reference exactly to the prevailing direction of wind, there is another aspect of the beneficial effect, capable of being produced. Such belts of trees are capable of largely preventing soil erosion on exposed slopes. In such an island as St. Kitts where, between the forests that occupy the tops of the mountains and the cane cultivation on their lowest slopes, there is a fairly broad strip of comparatively exposed grass land, such an area is liable to be much eroded by heavy rainfalls which occur not unfrequently in these islands, and the damage is spread to the cultivated area below. If such slopes were planted with belts of trees at various levels, the damage done by such occasional heavy downpours of rain would certainly be lessened, the water would be largely held up by these belts, and let out gradually, while each belt of trees would help to retain the useful surface of soil, and prevent it being carried by floods into the sea.

There is another point in favour of more general planting of belts of trees, and that is, that they are of value as a source of fuel supply. Wind-breaks, as was noted above, have to be kept within bounds as regards the spread of their branches. Consequently pruning and trimming ought to be regularly and consistently carried out. Such pruning would yield a considerable amount of wood available for sale as fuel, but the leaves from the prunings or trimmings would form an exceedingly valuable mulch for the neighbouring fields.

In conclusion, the two main uses of belts of trees are first, to shelter crops from strong and drying winds, and secondly, to hold water on exposed slopes which, if unchecked, rushes down, sometimes with uncontrollable force, carrying with it to the sea a large amount of the valuable surface soil.

X

Camphor growing in the British Empire.

Prof. P. Carmody, formerly Director of Agriculture of Trinidad, contributed to the Times Trade Supplement, April 10, 1920, an article on the above subject.

Although this subject has been dealt with in previous numbers of the Agricultural News, the opinions of Professor Carmody who is conversant with West Indian conditions seem worthy of attention. Most of the articles referred to is reproduced below.

The present high price of camphor invites attention to the possibilities of production within the Empire. Refined camphor is quoted in the price lists at about 2*s*. per oz., and 23*s*. 6*d*. per lb. The price fluctuates enormously ; five years ago the price per pound was little more than the price per ounce is now ; and as the production is practically monopolised by Japan, the price may be continually raised until consumption is checked by excessively high cost.

The world's requirements of camphor are estimated to be about 10,000,000 lbs. annually. The demand is increasing, notwithstanding the very serious obstacles to trade in a commodity liable to great fluctuations in price.

Supplies of commercial camphor come chiefly from Formosa, and the industry has been carefully fostered by the Japanese Government. If it be true that the camphor is obtained there by distillation of the wood, the annual destruction of trees must be very considerable, and this may account for the reports of diminishing supplies.

Within the Empire some serious, but so far not commercially successful, attempts have been made in camphor cultivation. Ceylon can claim priority in this direction. The tree was introduced there in 1852 but nothing more was done until 1893, when a consignment of seeds was obtained from Japan. The seedlings from these were distributed among plantations in different parts of the island, and from these about 1,000 trees were successfully grown. The results of this experiment were published in 1901, and it was shown that the growth of the trees was satisfactory at elevations varying from 250 feet to 6,000 feet above sea level, and that the yield of solid camphor from fresh prunings was about $1\frac{1}{2}$ per cent. It was estimated that the yield of prunings (6 inches to 8 inches long) would amount to 56,000 lbs. per acre per annum, and that with camphor at 2*s*. a lb. the net profit per acre per annum would amount to £ 74.

Notwithstanding this favourable estimate the production of camphor in Ceylon has not been a commercial success. It was stated in 1906 that over 100 acres were under cultivation, and that up to that year not more than 1 ton of crude camphor had been produced. At the time the wholesale price of refined camphor was about 4*s*. a lb. which, on the above estimate of yield, should have given a profit of nearly £ 150 per acre. At the present price of camphor the profits should be enormous.

In the Federated Malay States experiments are being carried out at the present time, and the distillation tests have shown a satisfactory yield.

In Mauritius the growth of the tree is satisfactory, but on distillation the prunings yield an oil which on analysis is shown to differ from the camphor oils of commerce; what is still more unsatisfactory, no solid camphor is contained in the distillate. From the point of view of future cultivation this is very important, for it has been recently confirmed in Trinidad, Dominica, and St. Vincent that some trees yield only oil and no solid camphor. A tree at St. Vincent is said to be over 100 years old, and does not yield solid camphor.

In Trinidad Professor Carmody has had an interesting experience with camphor trees. In 1908 some 200 young trees were found in the Botanic Gardens making such poor growth that it was decided to clear them out to make room for other plants. Although the soil was known to be poor, the growth was so stunted that it was concluded that camphor cultivation could not be recommended in Trinidad. Fortunately, it was decided to transplant about fifty of them into a better soil at the new Experiment Station. Here the growth was quite satisfactory, and a normal yield of solid camphor has been obtained on distillation. Its bushy habit of growth, and being an evergreen in addition, suggested the utility of the camphor tree as a wind-break, and as wind-breaks are of great importance in cacao cultivation, camphor trees could be advantageously substituted for the trees and plants (of no economic value) now used as wind-breaks.

In Dominica, plants obtained from Trinidad in 1911 have made satisfactory growth, and have yielded solid camphor.

The successful cultivation of camphor within the Empire is no longer doubtful. Hitherto no persistent effort has been made, owing probably to the great fluctuations in price. But the present high price of crude camphor (£ 31 per cwt. in Formosa), and the reported depletion of the native forests offer great inducements for further efforts within the Empire.

For future undertakings a few precautions are necessary. Seeds

or seedlings from trees that yield no solid camphor must not be used under any circumstances, stiff clay soil must be avoided, not more than 300 trees to the acre should be grown in good average soil, or not less than 12 feet apart in hedge rows, and a sufficient area (from 100 to 500 acres, if possible) for economical distillation. When the trees are four or five years old they can be clipped, and thereafter three or four times a year.—*Agricultural News, Vol. XIX, No.* 472.

XI

A Leaf Break Disease of Coconuts.

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A disease of coconuts, characterized by the breaking of the leaves, was first reported from Kurunegala in 1918. Since then cases have been observed in other parts of the Island. Affected trees are very conspicuous owing to the presence of leaves broken about the middle with the withered distal end hanging vertically downwards (see illustration).

The disease commonly starts at a terminal leaflet of one of the older leaves. The leaflet withers and turns brown. At the base of the dead leaflet, on the midrib, is a dark brown discoloured area which extends along the petiole as the disease advances, and which later turns black The disease advances rapidly, pairs of leaflets being killed in succession as the discoloured area progresses along the midrib. Eventually the leaf breaks, usually about the middle, sometimes nearer the base, and the withered end hangs downwards.

Some times the attack starts at a lateral leaflet. Then the discoloured area can be seen on the side of the midrib at the place where the leaflet is attached. When the discoloured area has extended across the petiole the whole of the leaf above the diseased portion withers owing to the stoppage of water supplies. Later the petiole breaks near the junction of the diseased and healthy tissues.

The breaking of the leaf is due to the weight of the diseased portions for only the horizontal or upward inclined leaves break. Old leaves which are hanging downwards, do not usually break when attached.

Cultures made under sterile conditions at Peradeniya from the junction of diseased and healthy tissues of the petiole, in every case developed a fungus *Botryodiplodia* sp. No other fungus developed in the cultures. So this organism may be considered the cause of the disease.

Fructifications of *Botryodiplodia* were also found in the field on the diseased petioles and leaflets. These fructifications appear as small black pustules which break through the epidermis liberating large numbers of black two celled spores.

No. 205, Leaf Break Disease of Coconuts. (Early Stage.)

Fungi belonging to the genus *Botryodiplodia* do considerable damage to numerous plants particularly hevea, cacao, tea, sugarcane, etc., The status of *Botryodiplodia* is generally admitted to be that of a saprophyte with powers of parasitism limited in most cases to the invasion of tissues (except fruits) with less than normal vigour. It unquestionably can kill healthy plants sometimes, but usually it merely hastens the death of plants which have been weakened by other causes. Most observers have found it difficult to infect healthy and even wounded plants with this organism. On hevea and cacao, in which it causes 'dieback,' it has been

demonstrated that entry is obtained only through wounds and dead tissues.

*Richards has carried out infection experiments in Malaya, on young coconuts but without result. It therefore appears probable that *Botryodiplodia* only gains entrance through the wounds or through tissues killed by other organisms, such as *Pestalozzia*. In this connection it may be stated that many fungi, of which *Pestalozzia palmarum* predominated, were found living on the dead parts of the leaves.

No. 206, Leaf Break Disease of Coconuts. (Late Stage.)

It is interesting to note that Stockdale " when investigating a leaf disease in Trinidad caused by *Pestalozzia palmarum* noted the symptoms of leaf break. When all the leaflets on the terminal 2-3 feet of the

*Agricultural Bulletin, F.M.S., Vol. V, p. 330. " West Indian Bulletin, Vol. IX, pp. 371—379. " West Indian Bulletin, Vol. XVII, No. 4.

leaf have been attacked and appear in a dry withered condition, this portion of the leaf breaks down, if the leaf happens to be floating in the air in a position between vertical upright and the horizontal. This end of the leaf rarely falls to the ground but remains hanging to the healthier portion and is very characteristic of the disease." Associated with this disease he found a fungus which he determined as *Diplodia* (probably equals *Botryodiplodia*) on the leaflets and petiole. In no case was *Diplodia* observed except on leaflets that had been previously attacked by *Pestalozzia*.

Nowell who investigated the Red Ring disease of Coconuts also observed leaf break in connection with this disease. In this case he considers leaf break to be a secondary symptom concerning which he says: " Development of patches of brown or black rot, wet but firm on the expanded leaf bases, and sometimes similar patches on the leaf stalk higher up. This appears to be the chief reason for the tendency for one to several of the leaves of affected trees to break, often at one to two feet from their insertion, and hang down. The patches here referred to seem invariably to develop crowded pustules of *Diplodia* sp. (which may equally well be designated *Botryodiplodia*.)"

*Richards records leaf break in the Malaya and attributes it to *Botryodiplodia* sp. He traces the progress of the disease culminating in the death of the palm. "Soon, the fungus growing rapidly in the tissues after the first stages, all the leaves are killed and hang down alongside the trunk, the leafstalks being broken at all positions. At this stage the youngest leaf is affected, the growing point succumbs to the attack and the palm dies."

From the above it would appear evident that *Botryodiplodia*, the organism causing leaf break, usually attacks palms of low vitality and those which have previously been infected by other diseases. Also the result of attack can be serious if the disease is left untreated.

Remedial measures must take the form of cutting off and burning the diseased portions of the leaf. This should be done as soon as the attack is noticed. The leaf stalk should be cut at least eight inches from the proximal end of the brown area to ensure cutting at a point beyond the limit of the diseased tissue, for the disease advances more rapidly in the interior of the petiole than at the surface. The portions to be destroyed should be burnt on the spot and not carried through the fields as the disease may be easily spread to other palms by means of the spores.

*Agricultural Bulletin, F.M.S., Vol. V, pp. 329-331.

As trees of low vitality are most liable to attack, such points as drainage, manuring and cultivation should be attended to for by increasing the vigour of the trees much can be done towards preventing attack by this organism.

The disease is most likely to occur where *Pestalozzia* or other leaf disease is prevalent. In these cases it may be necessary in addition to the above treatments to spray the palms with a fungicide, such as Bordeaux Mixture, as a preventive.—*The Tropical Agriculturist, Vol. LV, No.* 2.

XII

ELECTRO-CULTURE.

A General Review of the Subject.

BY

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At the present moment there is a serious world shortage of foodstuffs and of raw materials. Increase in production whether by increasing the area under cultivation or by the use of improved methods, is a vital necessity. In the present stage of the world's unrest it is highly probable that the shortage will be severely felt for a long time to come, and the maxim that the man who can make two blades of grass grow where one grew before is entitled to rank as a public benefactor, is probably more true to-day than ever before.

While it may not be immediately possible to double the yields from our present areas, still it behoves us to be ever on the alert to take advantage of any development that may tend in the direction of increased production, and it is fitting that serious consideration should be given to any practical proposal for increasing the fertility of the soil. It is with the object of directing attention to a somewhat obscure and little heard of branch of agriculture that the present account of the subject of Electro-culture is written.

Many people have a deep-rooted distrust of what they call "new-fangled ideas," and this, combined with the general lack of knowledge of electricity, has made them slow to examine the results or to take advantage of the benefits claimed for Electro-culture. Thus the matter has been left, and still is in the hands of a few enthusiasts, some of whom have conducted costly experiments for many years with varying success, but always with the indication that greatly increased yields were obtainable if only the electrical stimulus could be applied in the right way.

Historical.

The idea of stimulating the growth of plants by the use of electricity is not a new one. The earliest known experiments were carried out at Edinburgh by Dr. Mainbray, a Scottish physician, over 160 years ago (1746). Even before this time there seems to have been a popular belief that electrical discharges (thunder storms) were in some way concerned in stimulating the growth of plants. The general failure of the hop crop in 1787 was attributed, rightly or wrongly, to the almost entire absence of lightning for the season.

Mainbray experimented with young myrtle trees, and demonstrated that electricity accelerated growth. During the next fifty years his experiments were repeated and his observations confirmed by numerous experimenters. The scope of the experiments was gradually enlarged; tests were made with a great variety of plants, and some attempt was made as early as 1747 (the year after Mainbray's experiments) to explain the reasons for the various phenomena observed. The general results recorded were that plants when stimulated by electricity grew more vigorously, had larger leaves, and that they flowered and matured earlier.

In 1783 Berthelon was the first to attempt to apply the use of electricity to the production of crops, and he even went so far as to recommend its use as a remedy for fungus diseases and insect pests. It may be interesting to note at this stage that experiments conducted over 100 years after Berthelon's time, have also demonstrated that crops under the influence of electrical discharge suffer less from the attacks of fungus diseases than others. In this and in other respects Berthelon seems to have been ahead of his time. He also investigated the effect of electrified water on plants, and he electrified seeds by wrapping them individually in tinfoil. He seems to have been the first to consider some of the problems of electro-culture that are engaging most attention at the present time, and which will be discussed later. A quaint old print shows him mounted on an insulated truck being drawn around the garden while he applied electrified water to his plants.

For a period of 100 years after Berthelon's time nothing of outstanding importance seems to have been accomplished, till in 1885 Lemstrom commenced a series of experiments, and became the founder of much of the more modern experimental work in effects of electricity on plant growth. He states that his attention was first directed to the subject by observing the prolific growth of plants during his explorations in high (polar) latitudes. He suspected that this growth was due to the

electrical discharges associated with auroral displays, and claimed that the very structure of these plants—needle leaves of the pine and the awns of cereals—fitted them for collecting the current that is known to be passing from the atmosphere to the earth. On his return he began experimenting. His plan was to stretch above the ground a network of wires well insulated from the earth. These wires, which were provided with points making them look somewhat like barbed wire, were highly charged with electricity which escaped from the points across the intervening airspace, through the plants to the soil. This method, though modified by other experimenters (amongst them Sir Oliver Lodge) is still in use.

More recent developments include the electro-chemical treatment of seeds, but this aspect of the subject will be dealt with later on.

Modes of Application.

The results that have been collected by all of these experiments have established beyond all doubt that beneficial effects are to be obtained by the application of electrical stimulus to plants or seeds. The big problem is, "how can this stimulus be most economically and effectively applied ?" The experiments so far conducted fall into classes that differ mainly in the mode of application of the electric current :—

(1) Illumination by electric light.
(2) Conduction of atmospheric electricity from elevated conductors to the soil.
(3) Burying plates of copper and zink in the soil and using the soil as an electrolyte.
(4) Passing a current through the soil from external sources.
(5) Silent discharge from antennæ or overhead network.
(6) Electro-chemical treatment of seeds.

These classes simply represent the different methods used by various experimenters in their attempts to apply electrical stimulus to plants or seeds. A brief account of each of these methods may prove of interest. It is, of course, impossible in a brief review of this description to enter into a discussion of the precise details of the experiments. The results achieved are our chief concern. The use of technical language has, as far as possible, been avoided.

(1) *Illumination by Electric Light.*

Experiments in this direction were commenced soon after the discovery of the electric arc light, and many curious results were observed. It was soon discovered that the naked arc light caused damage to plants,

but when screened by a transparent glass screen the harmful effects were removed, and very beneficial results obtained.

The effect of the glass screen or a glass globe was to cut out the harmful rays. Numerous other forms of electric light, such as the incandescent electric light, etc., have been tried, and, generally speaking, the results have been good, though all plants are not similarly affected. The use of lights on a big scale is not practicable, so that its application has been restricted to market garden and greenhouse plants. Rawson—a Boston market gardener—has used electric light in raising lettuces for many years with great success. Lights of various colours have also been tried, and the development of produce can be hastened or retarded by their use.

The results obtained at the West Virginia Experimental Station may be summed up as follows (Bulletin 37) :—

(1) Electric light is beneficial to some plants for foliage lettuce.
(2) Leaves of deeper green.
(3) Flowers bloomed earlier and longer and were of deeper colour.
(4) Some plants tend to run to seed—spinach.
(5) Does not benefit all plants equally.

It is claimed that electric light is to be regarded as a valuable asset in the forcing of market garden and greenhouse produce, and in producing fruits and flowers out of season. Mr. Lunt, of Spreydon, New Zealand, has used electric light in his glasshouse for raising tomatoes. Light used from 9 P.M. to 5 A.M. gave beneficial effect on quantity, quality, and recovery from frost-bite. Apart from the stimulating effect of the light itself there is the factor of warmth associated with the light. Attempts have therefore been made to use electric lights with the object of preventing damage by frost. This is only possible where current is readily available at a low rate, as is the case where hydro-electric schemes have been carried out. The experience of Mr. Farr, orchardist at Fendalton, New Zealand, in this respect is interesting. In his pear and apple orchard he placed a 250-watt radiator in each tree with the object of preventing damage by frost. Frost-bite was prevented, and though there was no increased yield of pears the apples produced an abnormally heavy crop, and were ready for market a fortnight earlier than those in adjacent orchards.—*Journal of Agriculture, New Zealand, Vol. XV, p.* 185.

It was while engaged in investigating the effect of electric light on plants that Dr. C. W. Siemans (England) originated the term "Electro-Horticulture," which is still generally used for work of this description

though the wider term "Electro-culture" is now used to embrace the application of electricity in any way to the production of any sort of plant.

Writers in our daily papers occasionally draw attention to the abnormal behaviour of some plant or tree putting out leaves, etc., at some unusual season when situated within the sphere of influence of some street light. It is possible that such behaviour is in a measure due to the influence of the light.

(2) *Conduction of Atmospheric Electricity from Elevated Conductors to the Soil.*

Attempts to make use of atmospheric electricity by collecting it by means of elevated conductors for discharge either directly into the soil or from an overhead system of wires, seem to have been confined mainly to France. The possibilities of utilizing atmospheric electricity, and even the part that it undoubtedly plays in influencing plant growth, have never been adequately investigated, and little is known about the subject. That such an influence does exist was proved by Grandeau (1879) when he demonstrated that plants protected from atmospheric electricity had their development much retarded. A big field for research is left practically untouched. However, some experiments have been carried out. The general method employed is to attach a conductor to a tall tower, and to connect this with burried plates are net works of wire. Few accounts of these experiments are available, so that it is only possible to refer to them in passing. The cost of the installation would be considerable, and large increases would be necessary to justify the expense. The following results are recorded by F. Paulin, a French experimenter :—

(1) Increased per cent germination.
(2) Potatoes, 50 per cent increase.
(3) Cauliflowers, matured one month early.
(4) Beans and peas, 200 per cent, increase.

Experimental Station Record, Vol. XV., p. 361.

A cheaper method said to be very effective is to plant numerous metal stakes several feet long all over the field to act instead of one tall conductor. In the absence of details it is impossible to comment on the results beyond stating that further experimental work would be amply justified, though G. F. Lees, writing in the World's work (England), February 1919, does not regard the system as practicable.

(3) *Burying Plates of Copper and Zinc in the Soil, and using the Soil as an Electrolyte.*

This method, if it has nothing else, has at least cheapness and simplicity to recommend it. The writer has been able to discover very few

references to it, but the most important of these are quoted below.

In 1844 an American named Ross read a paper before the New York Farmer's Club describing his experiments. He buried a copperplate 5 feet long by 14 inches wide at one end of a plot and a similar plate on zinc at the other end 200 yards away. These plates were connected by an insulated overhead wire. The plot was thus made to act as a galvanic cell—the current flowing round the circuit when the wire was connected. He claimed an increased yield of 50 per cent of potatoes. Numerous other experimenters got contradictory results, and the matter does not appear to have received any extended attention. However, recent experiments show that increased yields of vegetables are obtainable by this means.—(*J. W. Crow—Annual Report, Ontario Agricultural College and Experimental Farm*, 34, 1908, *page* 150).

So little expense or time or trouble is involved that gardeners should be tempted to make a trial for themselves in a small, well-manured plot with smaller plates. Galvanized iron could be used instead of zinc.

(4) *Passing a Current through the Soil from External Sources.*

This was the method adopted by Mainbray in his original experiments, and his example was followed by many of the earlier experimenters. The process seems to have been rather overshadowed by the development of other systems which apparently gave better results. In 1894 C. Flammarion reported having stimulated the growth of beans by placing them between electrodes connected with a Leclanche cell (ordinarily used for electric bells, etc.).—*Experimental Station Record, Vol. XIV*, *page* 548.

No very striking success seems to have been obtained by this method but more recent results would indicate that it still has possibilities. Good results have been obtained by the use of carbon electrodes instead of ones of metal, and also by dusting the seed with fine metallic filings before sowing. There is some resemblance here to the method adopted by Berthelon, in 1783, when he wrapped seeds in tinfoil and electrified them before planting. Generally speaking, the results obtained by passing currents through the soil have not been promising. This phase of the problem does not seem to have been as thoroughly investigated as others but the latest developments would indicate the possibility of valuable results being obtained from the experimental work in hand.

(5) *Silent Discharge from Antennae or Overhead Network of Wire.*

This method of applying electrical stimulus to growing plants was greatly developed by Lemstrom (1885) though attempts had been made

to use it long before his time. The system is of great importance, because it is the one that has claimed most attention ever since.

Lemstrom's work gave rise to a great number of experiments, some of which are still in progress. Subsequent experimenters modified his methods greatly, but the general principles remain the same. It is known that the atmosphere is charged with variable quantities of electricity, and that the charge is continually leaking away to the ground through the plants. The charge is very variable, being small in normal weather, but increasing with thundery conditions, when the leakage becomes correspondingly greater. In the system under consideration there is spread over the plants a net work of fine wire so highly charged with electricity that it is discharged into the air, and increases the current passing from the air to the plant to about ten thousand times its normal value.

The current used may be derived from various sources, *e. g.*—

(*a*) Atmospheric electricity.

(*b*) Dynamos driven by small engines.

(*c*) Town supplies.

The use of atmospheric electricity in this respect has been largely confined to continental countries, and experiments are still in progress. Reports of the experiments of Berthelot (distinct from Berthelon) at Heudon and of Basty at Tours (France) state that that beneficial effects were obtained in all cases (E. S. R. xx., page 1124). Experiments have also been carried out in Italy, but apart from some experiments by Foster (England) as early as 1844, the use of atmospheric electricity has been neglected in English-speaking countries. Foster conducted the current derived from the atmosphere to wires spread over a crop of barley, and claimed that he had obtained a greatly increased yield.

The greatest development, however, has taken place in the use of dynamos and of town supplies as the source of the current. The general method is to pass the current through the primary of a coil, and by this current is alternating in character—going first in one direction and then in the other. By means of specially designed valves the current is allowed to pass in one direction only, and the alterations are eliminated. Thus a potential of about 100,000 volts is kept up in the overhead wires, causing them to glow in the dark, and to discharge with a slight hissing noise. Great care has to be taken with the insulation of the wires from the ground.

The equipment is costly, and wires are hindrance to Farm operations. Mr. Britton, experimenting at Chestor, estimates the cost of an

installation for 24 acres at £300 with an annual upkeep of £63, while a system for 300 acres would cost £1,500. This estimate was made in 1917, and the cost would be a great deal higher at the present time. (Engineer, Vol. 124, page 74).

From this it will be seen that experimental work is greatly hampered by the fact that a cheap and effective type of apparatus is not yet available.

In spite of the heavy costs a great number of experiments are still in progress, and the results are sufficiently striking to justify a great deal more investigation. It has only recently been discovered that the effect of the discharge is not confined to the area under the wires. It extends 30—40 yards on either side in calm weather, but if the weather is windy the influence extends several hundred yards down wind. The control areas cannot therefore be placed within hundreds of yards of the experimental plot. In some of the earlier work the control areas were affected by the discharge, and much contradictory evidence was obtained. The Board of Agriculture (England) has investigated the matter, and the results obtained by reliable experimenters can scarcely be questioned. Some of the results are quoted below :—S. E. Britton, Chester, England (1918).

Increase in yield of potatoes, 150 per cent. *Electrical World, Vol.* 73, *p.* 783.

Miss Dudgeon, Lincluden, Dumfried (1916).

Increased weight of grain, 49 per cent.

Increased weight of straw, 88 per cent.

Kind of crop not stated.—*Engineer, Vol.* 123, *p.* 450.

Potatoes :—

Variety	Increase per acre.
Ringleader	2 tons 4 cwt.
Windsor Castle	1 ton 17 cwt.
Golden wonder	13 cwt.
Great Scott	1 ton 10 cwt.

Cost of application, £ 4-7-6 ; area 8 acres. Tubers ready a week earlier.—*Journal, Board of Agriculture* (*England, Vol.* 23, *p.* 671.)

P. Van Bierviet, Pringsheim, Germany (1904).

Increase for strawberries	125 per cent.
Increase for barley	32 ,, ,,
Increase for beet	119 ,, ,,
Increase for beans	30 ,, ,,

Experimental Station Record, Vol. XVI, p. 557, *Newman, Salford Priors, Evesham* (1906—1911).

Area, 19½ acres.

Increase for wheat	20 per cent.
Increase for barley	5 „ „
Increase for mangolds	25 „ „

Engineer, Vol. 124, *p.* 74 (1917).

The great majority of the experiments have yielded highly encouraging results, but a number of cases have occurred in which the results have been disappointing, and in which the increased yield was not sufficient to justify the expense of application. It is generally agreed that, before the system can be recommended, more knowledge is necessary on many points. The most suitable strength of discharge is not yet known, and the manurial conditions and the effects on different types of soil are not understood. Experiments are still in progress with the object of throwing more light on to these points.

The assumption underlying the work is that the passage of a small electric current through the plant is beneficial to it, and tends to increase yield and very often to lessen the time in which that yield is obtainable. It is thought that there is an optimal value for each special plant concerned and that this value is variable for different plants, and even for the same plant at different stages of its development. Currents in excess of these optimum values will cause harm. Electrified plants transpire more water, and are therefore liable to suffer if treatment is continued in dry weather. The disease resisting power of a plant is largely a function of its vitality the more virile plants escaping disease. Numerous experiments have observed that electrified plants were freer from fungus diseases than others in the vicinity. Another advantage claimed is that the succeeding crop is also greater. In addition, there are important differences in the quality of the crop—cereals showing a higher percentage of nitrogen compounds, and beets an increase in sugar content. The experiments have until recently aroused little more than local interest. About 1910, Professor Breslauer (a German), visited Mr. Newman's installation at Evesham, and was struck by the significance of the experiments. Having secured the agency for the apparatus, he very soon sent in more orders for sets than there had been inquiries in England. Six sets of the Lodge-Newman apparatus were delivered and installed in various parts of Germany. Reports say that good results followed. Though excellent results have been obtained from this method, the lack of precise and definite knowledge on many points leads to the conclusion that there is

not yet a sufficiently strong case to warrant the general application of this method to crop production. It is already known that dry conditions are quite unsuitable for its successful working, and this in itself would be a powerful argument against its adoption except in special cases in Australia.

(6) *Electro-Chemical Treatment of Seeds.*

Recent developments in this phase of electro-culture indicate that it is in this direction that we may expect the most practical developments to take place. It is rather difficult to trace the history of the subject, and it is probable that the work of many of the pioneers did not receive much publicity. Some credit is due to the old experimenter, Berthelon, who electrified seeds by wrapping them in tinfoil. His treatment was not electro-chemical; still he arrived at the same result—electrified seeds by a different process.

One of the foremost workers along this line of development is Mr. H. E. Fry (Dorset), whose work has recently attracted a great deal of attention. The method adopted is to pass a current through a solution in which the seeds are immersed. The solution is then drained off, and the seeds dried and sown within a month. Details of current, solution, etc., are not disclosed. Mr. Fry started by sowing seeds in pots, and later in a garden plot. He had some difficulty in pursuading a neighbouring farmer to plant some treated seed. The results were so striking that they attracted the attention of other farmers, and in 1918 over 2,000 acres embracing all types of soil were sown with electrified seeds by 500 farmers. The increase in yield ranged from 6 bushels up to 16 bushels to the acre. The British Board of Agriculture investigated the matter, and reaped, threshed, and weighed samples of the crops, and found an average increase of 10·5 bushels per acre to the credit of the electrified seed. The average gain per acre of eleven farmers, after deducting the cost of treatment, was £4 13*s*. These figures are so extraordinary as to cause doubts as to their correctness, but they can be accepted without the slightest hesitation coming, as they do, from the British Board of Agriculture, and from experts, representing various agricultural societies, who supervised the work.

Not only was the yield vastly increased, but the quality of the grain was superior. The bushel weighed from 1 to 4 lbs. heavier, was of better milling quality, and produced less offal and more flour.

An even more important effect is to be found in the increase of resistance to rust and other fungus diseases. This was also observable with the use of the overhead discharge already noted. There was also an

increase in the quantity and quality of the straw, which tillered out better, and was invariably longer, stouter, and stronger, and less liable to be blown down by storms. It seems to be a very extraordinary thing that the mere passing of an electric current through a solution containing the seeds should so profoundly affect their vital functions as to stimulate germination, growth, resistance to disease, earliness of maturity, and even to modify the quality of the grain and straw produced.

A great deal of experimental work is still necessary, and the proper treatment for each kind of seed and for each type of soil can only be determined by long series of experiments through a period of years. Even with the present knowledge the process can be regarded as established in England. The officer in charge of American interests in Great Britain after a tour of inspection advised his Government to have immediate trials made in every State of the Union.

The cost of the apparatus required is not great, and its handling very simple. The system devised by Mr. Fry is known as the Wolfryn process, and is protected by patent rights.

Experiments were carried out by Mr. Butterworth in South Australia years before Fry started to work. He obtained striking results, and planted out a considerable area with treated wheat. Mr. Butterworth died before the crop was harvested, and the results are not known. Mr. Chas. Barclay, Corney Point, South Australia, is also said to have increased his yield 40 per cent on 60 acres, but no further results are available. Experiments were also carried out at the Hawkesbury Agricultural College by passing a current through the ordinary copper sulphate pickling solution. Though Mr. Fry's work has attracted so much attention as opening up a new phase of the subject, it must not be forgotten that he was preceded by many years by several Australian experimenters.

The attention of those interested in the subject is directed to a full-page article in the Sydney Mail, 25th February, 1920. It gives an account of results obtained by a correspondent in experiments with various vegetables. It also mentions the case of a lady experimenter in Queensland who used a current generated by running the lighting gear on her car. A further account of the subject appears in the February number of the Journal of the Institute of Science and Industry. Numerous inquiries have been made for information as to the solution to be used and its strength, the time of application of the current and its strength but an exhaustive search through the literature bearing on the subject does not disclose these details so that those desirous of experimenting

must either wait till details are available or start of as original experimenters. Experiments are at present being conducted at the Burnley School of Horticulture and Primary Agriculture.

A book—A Manual of Electro-Chemical Treatment of Seeds, by Dr. C. L. Mercier—is at present in course of publication, and it is expected that when it is available* it will disclose the details of the process.

Explanation of Results.

Some attempt was made in 1747 to explain the results obtained by Dr. Mainbray in the preceding year. While many of the observations made since then are undoubtedly correct, it cannot be said that any satisfactory explanation has yet been put forward. The electric stimulus causes increased transpiration from plants and fruits, hence early observers ascribed the results to the accelerated motion of the cell sap through the plants. Others consider that electricity renders certain soil constituents more soluble, but this neglects the fact that seeds can be stimulated apart from the soil.

Bains, in a recent work, concludes that the use of low electro-motive forces in agriculture and floriculture is in accord with natural laws, as these currents are always flowing, and slight increases applied in the right way at the right time may result in some benefit.

Other recent observers ascribe the result to increased aeration of the soil, the production of minute quantities of nitric acid and the stimulation of bacterial activity. None of these factors would be operative in the case of electro-chemically treated seeds.

It must be remembered that we are applying a very little understood force to an organism the interior and essential processes of which are still largely unknown to us. The outstanding fact seems to be that electricity, provided the current is not too great, no matter what its source may be, and no matter what mode of application is adopted, exercises a stimulating effect on germination, growth, and maturing of plants, but the reasons for it are mainly shrouded in mystery.—*The Journal of Agriculture, Victoria, Vol.* 18, *part* 7.

XIII

The Fertilization of Citrus Orchards.

For many years past the consideration of questions relating to the important citrus industry in California has received careful attention by the scientific staff of the College of Agriculture and the Agricultural

* This book is now available.

Experiment Station of the University of California. In the annual report of the Director of the Experiment Station, for the year ended June 30, 1919, the results of experiments with regard to the fertilization of citrus orchards are recorded. These experiments, and the conclusions reached from them, seem worthy of attention to growers of citrus crops elsewhere.

These fertilizer experiments have been carried out on a uniform plan for twelve years. The results, judged by the yield and the appearance of trees, emphasize the great importance of organic matter and nitrogen in citrus fertilization, and the comparative slight importance, on Californian soil at least, of phosphoric acid and potash, in the opinion of Dr. Thomas F. Hunt, the Director. The plots treated with stable manure and raw rock phosphate, on which a leguminous cover crop is grown each winter and ploughed under in early spring, continued to show a superiority over those otherwise treated. Plots treated with chemical fertilizers, such as nitrate of soda alone, or in conjunction with sulphate of potash, superphosphate, and dried blood, have gradually deteriorated, showing increased quantities of mottled leaf, and are now much inferior to plots that have received organic matter. Nitrogen and organic matter therefore appear to be the most necessary requirements of the soil on which these experiments are carried out.

An experiment was started in 1915 for testing various methods of treatment in an attempt to rejuvenate a twenty-five-year-old run-down navel orange orchard. It is stated that in 1919 the mulched plots gave the highest yield, with an average crop of 203 lb. of fruit per tree, but the trees on these plots had not in general a healthy appearance. The plot with alfalfa hay worked in stands second in yield, with an average of 184 lb. per tree, and the trees were not nearly so badly mottled as they were. Several other plots treated with various combinations of artificial fertilizers gave a yield varying from 175 lb. to 153 lb. per tree. Twelve stable manured plots, without additional nitrogen, gave an average yield of 142 lb. per tree, while eleven unfertilized plots only yielded 95 lb. per tree. The trees, however, which apparently have improved most in health, judging by their appearance, were those on a plot which received 20 cubic feet per tree of stable manure.

Repeated studies on the use of green manure in citrus orchards continue to emphasize the importance of the practice. Several species of leguminous cover crops continue to give most satisfactory results. Recent experiments have brought out the importance of using green manures in young citrus orchards to improve the soil while the trees are developing. In the 70 acre orchard, which was planted at the Citrus Experiment

Station in the spring of 1917, an extra effort has been made to improve the soil fertility, as the land had been under grain crops for many years and was much rundown. Black-eye beans have been grown between the tree rows each summer, and bitter clover (*Melilotus indicus*) sown broadcast over the entire area in the winter. The black-eye beans yielded the first year 720 lb. per acre of seed and about 1,000 lb. of straw, and the second year 1,837 lb. per acre of seed and about 3,000 lb. of straw. The sale of these beans more than paid for the cultivation of the orchard. Each harvest, after threshing the bean straw, has been returned to the land, applied uniformly in furrows about 12 inches deep, ploughed on each side of the tree rows, and the furrows filled in after the straw is applied.

The winter cover crop was allowed to grow until the later part of March and then ploughed under. The first year this cover crop averaged about 19 tons of green material per acre, and the second year about 18 tons per acre. The orchard had no other fertilizer, but under this treatment has made a remarkable growth, even though an exhausted soil was used, and no application of manures of any kind has been made except the green manure grown on the land with the tree. The results illustrate the importance of using green manures in young orchards to build up the soil while the trees are young.—*The Agricultural News, Vol. XIX, No.* 475.

XIV

The Limitations of Tractors.

Manufacturers of tractors claim that they are rapidly displacing horses on the farm. Horse breeders assert that they are not, that horses have not lost in numbers and that as a means of producing farm power their position has not been shaken. In view of the controversy the annual horse and tractor censi of the United States since the tractor became much of a factor on the farm are interesing . In 1914 there were 20,962,000 horses and 15,000 tractors were manufactured ; in 1915 21,195,000 horses and 21,000 tractors ; in 1916, 21,159,000 horses and 29,670 tractors ; in 1917, 21,210,000 horses and 62,670 tractors ; in 1918 21,555,000 horses and 132,690 tractors, and in 1919, 21,534,000 horses and 314,936 tractors, the last figure is based on manufacturers' forecasts.

The horsemen seem to be right. In spite of heavy exportations to fighting European nations and the rapidly increasing use of tractors on farms horses have held their own. At the same time tractor sales are increasing rapidly, and a selling argument used by tractor companies

is that the tractor will do away with a large number of horses. That argument is evidently misleading.

An investigation conducted by the University of Minnesota showed that the type of farming has much to do with the horse-displacing value of the tractor. This will, without question, hold true in all states. It was found that when corn is grown as many horses are required for cultivating as for ploughing. Then it is absolutely impossible to reduce the number of horses by the use of a tractor unless it be adapted to cultivating or unless a special motor cultivator be added to the power equipment of the farm. It was likewise found that in the small-grain region the ability of the tractor to displace horses depends upon the extent to which it can be used for other field operations besides ploughing. Seeding, disking and harvesting require nearly as much time as ploughing. The conclusion is that merely ploughing with the tractor will not reduce the number of horses which the farmer has to keep. The farmers of Kittson Co., Minn, who farmed the most land with the least number of horses, were the farmers who were able to use their tractors for the greatest number of farm operations beside ploughing.

It seems that most farmers buy a tractor primarily for the purpose of ploughing with little serious thought of using it for other operations except some belt work. Ploughing is heavy work and in hot weather and under heavy pulling conditions it is horse-killing work; consequently horse ploughing cannot always be as deep as it should be. To plough deeper, faster and more steadily is the predominating purpose of most tractor purchasers.

As a consequence of the little thought given to the performance of other farm operations with tractor power it is evident that few horses are completely supplanted by the tractor. The burden of the horse is merely lightened while he is fed, watered, pastured and cared for 365 days of the year. The tractor has proved his friend, not by any means his enemy.

In the meantime farmers have added the price of a tractor to their working investment and have another mouth to feed. This new mouth requires gasoline or kerosene, and although it eats only when it works it eats right heartily and expensively. There can be little financial economy in its use, if any, at all. Either the farmer places an over high valuation on tractor ploughing and the belt work which he can do with tractor, or he is misled into thinking it an economical investment. If neither of these is true then he must have so much money that he does not worry about expenses.

The horsemen's arguments about the ease of handling the horse and its ability to furnish power for every farm operation, with a greater uniformity of success under varying conditions, are well founded. The reason that tractors have caused no appreciable decrease in the horse population on the farm is as much because they lack the flexibility of the horse and its ability to do every variety of farm work as for any other reason. Although the tractor is proving a good assistant to the horse it is not by any means a success as a supplanter of horses. Until the tractor is built which can be used as satisfactorily and conveniently as horses in the performance of every kind of field work, from the beginning of the season to the end, the horse's position will not be menaced. The lack of this versatility in the present day tractor keeps the horse on the farm.

Looking toward a horseless future on the farm, with a tractor that will really do away with horse labour, we can see that the horse would not be dominated by the tractor at once. The tractor, like any other machine, is no better than its operator. A mule will not drink impure water, but the tractor will drink mixed water and gasoline without hesitation and suffer therefrom. The tractor has no brains ; it is controlled entirely by the brain of its operator. Among farmers mechanical knowledge, aptness and interest run the entire gamut from zero to par. With the operator's mechanical knowledge governing the success of the tractor it follows that the satisfaction given by its operation will also vary widely.

It is hard to teach an old dog new tricks, and many old style farmers would be of little faith as regards a tractor as a complete horse displacer. For that reason it would be only with fear and trembling that they would part with their horses and place their entire trust upon a man-made machine. Possibly just as boys become natural ball players from growing up with a ball and a glove, the coming generations who grow up with tractors will become natural tractioneers. They might be able and competent to place their entire trust in a tractor successfully when they take command of the farms, and their sons might likewise take naturally and confidently to tractor power exclusively.

In the meantime tractor manufacturers will be simplifying their tractors, and making them as nearly fool-proof and as durable as possible. We can remember well when the first automobile came to town, scared the horses and ran spasmodically. When it went it was marvelous, but generally it was out of order, and something had to be fixed before it would go further. The automobile manufacturers stuck to their guns, thought, and studied, improved and made automobiles what they are today. Only a short time ago they were regarded with dis-

trust; now we all want one. How many people knew what a carburetor or a magneto was a few years ago? Automobiles have taught us much about gasoline engines.

It took only a few years for the airplane to come up from what generally was considered as wild a dream as that of perpetual motion to its present stage of improvement. So why should not the right kind of tractor displace horses in the farm field work as completely as the automobile displaced the horse and buggy? Let one man commence something along a mechanical line and he will study it, experiment with it, improve it and ultimately develop it to the point of complete success. If the day of the tractor does not come, then all the precedents set by the development of the steamboat, steam engine, motor-cycle, submarine, automobile and airplane will be broken.

But the first step in this direction will have to be the production of a tractor that is literally an iron horse in its versatile ability to work in the field under all conditions. Not until this kind of a tractor is produced need the farm horse worry about losing its position and its home.—*The Breeders' Gazette, August* 26, 1920.

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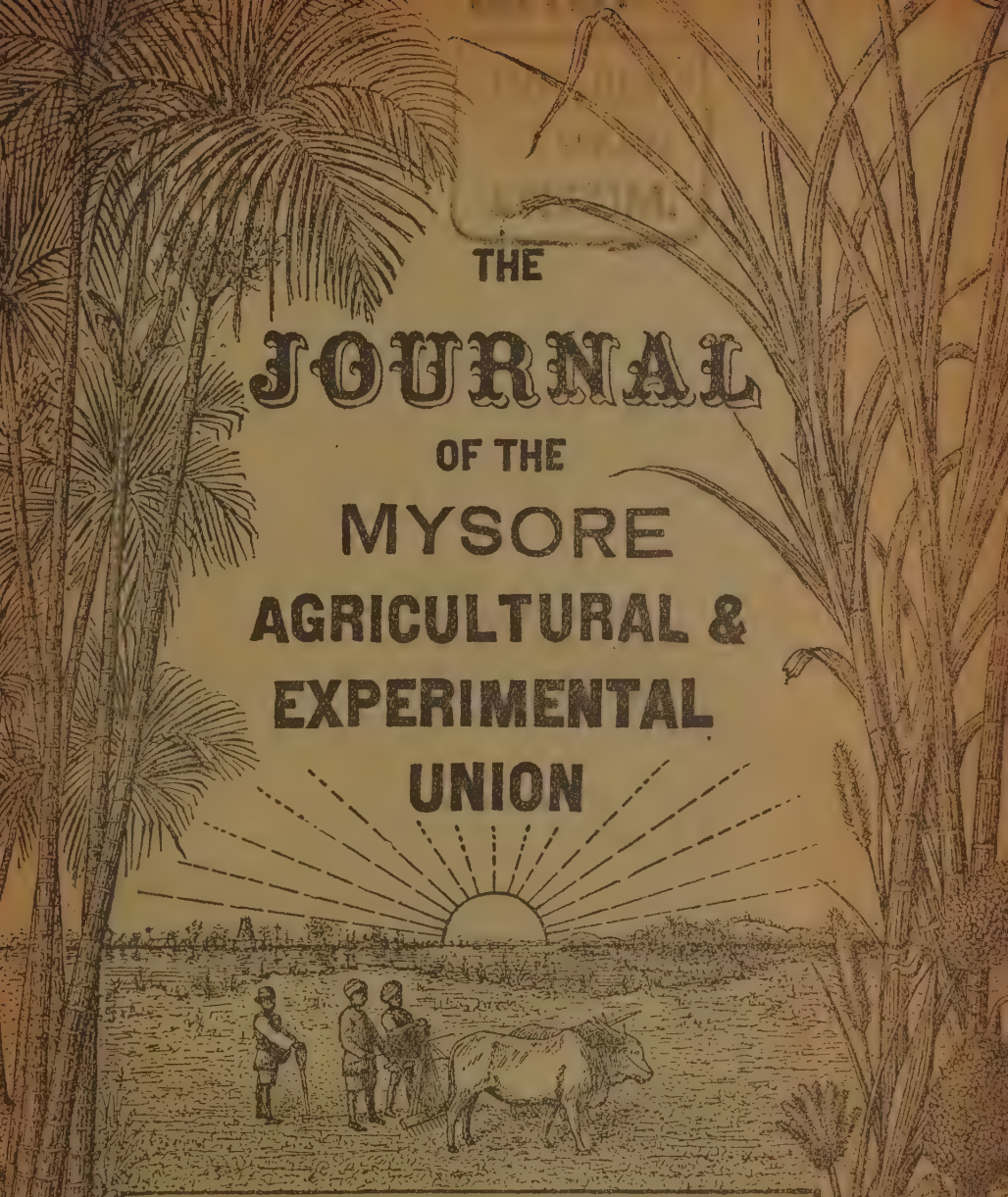

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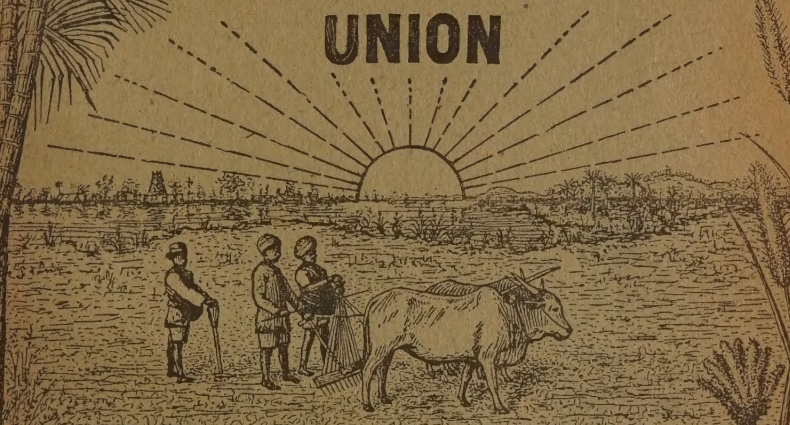

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